MGIPC—S4—III-1-93—22 8-45—5 000

SCIENCE

NEW SERIES. VOLUME XLVIII

JULY-DECEMBER, 1918

NEW YORK
THE SCIENCE PRESS
1918

THE NEW ERA PRINTING COMPANY,
41 North Queen Street,
Lancaster, Pa.

CONTENTS AND INDEX.

NEW SERIES. VOL. XLVIII.—JULY TO DECEMBER, 1918

THE NAMES OF CONTRIBUTORS ARE PRINTED IN SMALL CAPITALS

SCIENCE

FRIDAY, JULY 5, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

CONTRIBUTIONS OF ZOOLOGY TO HUMAN WELFARE[1]

MY colleagues in this symposium have emphasized the important contributions to human welfare which have come from zoological research and the application of the resulting discoveries. On the contrary, I shall tend to stress the contributions which biology, and in particular zoology, may make through education which aims to extend scientific knowledge to everybody. Moreover, my colleagues have chosen to speak concerning the contributions of zoology to human welfare in lines which are directly useful with reference to the physical well-being of the human race. Hence they have emphasized the practical bearings of zoological science in its applications to the production of useful animals and plants and in the relations of certain animals to human health. In short, a strong case has been made for zoology as a science which has immensely important contributions to the economic and hygienic welfare of the human race. With all this emphasis on zoology in its direct material or physical bearings on human life, I most heartily agree. As a matter of education, I believe in "applied zoology" which stresses the science of animals as they economically or hygienically affect mankind; but I regard zoology limited to its direct material usefulness, to its contributions to physical human welfare, as failing to develop the possibilities of the science as it may affect racial welfare and intellectual welfare. Hence, I have devoted my paper to zool-

[1] Read by title before Section F, American Association for the Advancement of Science at Pittsburgh, December, 1917.

ogy (1) as it concerns human intellectual welfare and (2) as it concerns racial welfare.

I. BIOLOGY AND INTELLECTUAL LIFE

One who studies critically the educational essays of the pioneer educator-biologist, Thomas Henry Huxley, must be deeply impressed with the important relations and possible applications of biology to daily life. In Huxley's remarkable address, "The Educational Value of the Natural History Sciences," delivered in 1854, and in those maturer ones, "On the Study of Biology," in 1876, and "Science and Culture," in 1880, Huxley grasped the vast significance of biology in relation to human life at the fullest development of its physical, intellectual, ethical, moral, and esthetic possibilities. Looking, as he always did, at human life and science and education with a far-reaching vision, Huxley needed for his own estimate of the value of science no such a sharp distinction between pure science and applied science as has become common in these later years. To most educated people to-day the terms "applied science" or "practical science" suggest some phase of technology, such as industrial chemistry, or electrical engineering, or scientific housekeeping, or modern agriculture, or hygienic problems; in short, applied science now commonly means the use of science in the material or physical affairs of life. Rarely indeed do we now find educational discussions which consider science as applicable to the intellectual and emotional aspects of the life of educated citizens. No such a limited view of applied science appealed to Huxley. He saw clearly many applications of science, and of biology in particular, to the intellectual and emotional aspects of life in addition to the physical or material welfare to which he often gave appropriate emphasis. I refer especially to his lecture "On the Study of Biology," only one of many lectures in which he showed that to him biology had an applied or practical bearing on our lives through the intellectual or philosophical problems which evolution and other scientific doctrines have forced to the attention of most well-educated people. Huxley illustrated his view of the higher intellectual value of biology as applied science by pointing out the great significance to intelligent people of the evolutionary theory of man's relation to nature. Evidently, this theory has nothing to do with biology applied to the material affairs which affect our physical welfare, for it is of no value in hygiene, agriculture, or other practical applications of biology; but I think that most of us will agree that courses which do not open up for students the great intellectual value of evolution and other biological theories do not deserve to be named either pure biology or applied biology. In fact, I have come to believe that no phase of biology which has a purely physical application to human welfare, such as bacteria and disease, or biology applied to agriculture, is more important for the *average* educated citizen than a general understanding of the evolution theory. Hence, I urge that our conception of applied biology for general education must be large enough to include the intellectual as well as the more directly practical aspects which affect human welfare economically and hygienically.

Summarizing Huxley's views of biology as applied science, biological knowledge is practical, utilitarian and applicable to human welfare (1) in many lines (*e. g.*, agriculture) which are industrial or economic, (2) in hygienic problems aiming at life conservation, (3) in esthetic outlook upon nature in general, and (4) in intellectual or philosophical interpretations of human life in its relations to nature. It is such an ex-

tended outlook upon biology as applied science in the larger sense that we now need for the purposes of general and liberal education. We are living in an age that is eminently industrial, commercial and practical. There are signs that we tend to consider education as productive of results measurable in purely material terms. If we follow closely such tendencies while we are reorganizing biology into applied science, we are likely to interpret the word "applied" as limited to the material and especially the commercial affairs of life, and then we shall leave no place for the intellectual and esthetic values of biological study.

I have thus at some length advocated a larger conception of biology as applied science that functions in our daily life in that it definitely concerns intellectual welfare. This is why I believe in education that present applied biology in the largest sense of the word "applied," namely, biology that sets forth in bold relief the great facts and leading ideas which touch human life in its combined economic, industrial, hygienic, intellectual and esthetic outlook. Applied biology, then, should be understood in the larger sense as meaning a selection from the vast field of biological learning of those facts and ideas which are likely to mean most in the life of the average educated man and woman. Thus, zoology may through education come to make the greatest possible contribution to human welfare.

There has long been a feeling, even among scientific men themselves, that the philosophical applications of biological generalizations are more or less interesting for the purposes of mental gymnastics; but that they have no important bearing on the practical relations of science to human life. How often have we heard the theory of evolution referred to as a strictly pure science generalization without possible application to practical affairs. In all this we seem to have been decidedly in error, for we have overlooked the fact that a philosophical application of a pure-science theory may come to be a guiding force in the material affairs to which science is directly applied. Such is the case in the relation of certain phases of evolutionary philosophy to the Great War.

A striking illustration of the profound bearing of philosophical biology, particularly zoology, on human welfare is found in the German justification of the present world struggle which seems to be opening the way to overwhelming revolutions of our economic, social, political, ethical and even religious systems. It is clear to many American men of science that the German philosophy of the superior state or nation and the superior race or people and the superior qualities of Kultur of the people as a group is at bottom an evolutionary philosophy based on the German zoologist's conception of the Allmacht or all-sufficiency of the Darwinian theory of survival of the fittest in the universal struggle for existence among living things. This biological principle in the extreme interpretation of Neo-Darwinism has been widely adopted by influential German philosophers.

Of course the German doctrine of superiority is not all an application of philosophical biology, for there is obviously an admixture of the peculiar religious state of mind characteristic of many German writers in the universities and in the government. As proof of this we may call to mind the long-standing dual alliance between the Kaiser and his Gott; and judging from many fervently religious phrases in imperial proclamations relating to "glorious" victories in Belgium and Serbia, the mutual understanding between Wilhelm II., and his invisible and silent partner continues to exist. However, we must not allow the religious attitude of those at the center of

the Hohenzollern dynasty to lead us to believe that religion is the determining factor in establishing the prevailing German attitude regarding war as the justifiable method of extending their assumed superiority. The members of the Kaiser's family may sincerely believe, because they have been educated to believe, in their divine rights and affiliations; but it is impossible that traditional religion has played more than a minor part in developing the clearly evolutionary philosophy of German superiority that has spread centrifugally from the universities, especially through the influence of many writers who were not liable to classification as religiously inclined. Perhaps the religion of the people of the masses has led them to accept as a religious idea the doctrine of superiority made by German evolutionary thinkers and spread broadcast by the means of an educational system that with marvelous skill was planned to promulgate and ultimately to put into world-wide practise the clearly evolutionary doctrine of German superiority over the rest of mankind.

In biological philosophy intellectual Germany seems to find good in this war, and indeed in all wars, as a means of expressing force or might of the state, which in the German national philosophy is always right because the fittest win in the struggle.

Of course it matters not, so far as we are inquiring into the possible influence of biological philosophy on human welfare, that numerous German biologists and philosophers have accepted an evolution factor whose Allmacht has long been denied by the great majority of biologists outside of Germany. For our present purposes the fact is that, whether right or wrong, a biological theory has been made to support a national state of mind which is now threatening the very foundations of human welfare. Of course it is beside the point, but to a biologist an interesting question, whether Neo-Darwinism has been widely accepted by the intellectuals of Germany because of scientific facts in its favor or because it fitted in with a previously accepted doctrine of right determined by might. Be that as it may, the one conclusion I wish to draw from the German philosophy of superiority is that we should find an important lesson in the fact that a theory largely zoological in its origin and in its human applications has been brought into conflict with human welfare as we Americans see it with the larger vision.

I have arrived now at my main thesis that only through organized education can the physical and intellectual values of zoology be made to contribute to human welfare in the largest sense. The fact that the German superior state of mind to which we object was developed by national education, and education thus worked against human welfare, is obviously no argument against education, but only against a phase of education limited to the purposes of those in power.

II. ZOOLOGY AND EUGENICS

I come now to the relation of zoology to racial welfare, in other words, the problem of eugenics. It is evident that the application of the laws of heredity or genetics to the breeding of more useful animals is simply another aspect of economic zoology; and one whose total financial value is bound to continue to be greater than that of all other phases of practical zoology combined. We need only compare in cursory survey any of our valuable cultivated or domesticated strains of the animals and plants of agriculture with the most closely related wild forms in order to realize the vast economic significance of man's applications of known and unknown principles of heredity.

On the other hand, the human problem of applied heredity or eugenics is far from being such a simple business problem because the desired results can not be evaluated on a purely economic basis. In short, eugenics, unlike the biologically parallel breeding of animals and plants, is not a phase of economic zoology, except perhaps in the indirectly involved economic problems arising from human defectives and inefficients. Eugenics is at present a biological philosophy and must be developed and promulgated accordingly, namely, through education. As the biologist so well realizes, the production of better human strains involves not only the physical problems of heredity but also the vastly more complicated social, emotional and religious traditions which concern human families as they are organized to-day. Before established biological principles of heredity can be applied to the human race, either by individuals or by nations, a eugenic philosophy must be accepted. This is the next and necessary step in the program of the eugenic movement. More research may bring stronger conviction that the eugenic proposals are scientifically true; but little progress can be made except through an educational movement which distributes widely among intelligent people a eugenic philosophy which deals adequately with the biological, social and other factors involved. Such an educational movement for eugenics must be based on biology, and especially on zoology which more directly illustrates human life and its problems. By education I do not mean schools and colleges only, for I am thinking of the vast possibilities of popular education such as in the past year has been applied by lectures, magazines, newspapers, pamphlets and posters to the great food questions. An energetic and sweeping educational campaign will some day be necessary if the average intelligent citizen is to be made to realize what the eugenic proposition may mean for racial welfare. Here is a possible contribution of zoology to human welfare compared with which all others are of minor importance. As in the case of those philosophical principles of biology which may profoundly influence human thought and action, there is now in sight only one pathway leading towards progress in applying the established biological science to eugenic practise. That pathway is labelled "Education."

MAURICE H. BIGELOW

TEACHERS COLLEGE,
COLUMBIA UNIVERSITY

SCIENTIFIC EVENTS

VOLCANOES OF HAWAII

THE entire group of Hawaiian Islands, twenty in number, extending in a chain for hundreds of miles, is of volcanic origin, though some of the islets and reefs are but the wave-battered remnants of volcanoes whose fires died out long ago. The island of Hawaii has been formed by the coalescence of many recently formed volcanoes. The walls of the crater of the active volcano of Kilauea, on this island, are broken down on one side, giving access to its "lake of fire." This volcano has not always been gentle in its ways, but it is now so well behaved that the visitor can stand safely on the edge of its fiery pit and, if the volcano is active, watch the molten rock boiling and spouting 100 to 300 feet below. Sometimes many fountains throw up jets of glowing sulphurous lava and light up with ghastly glare the frowning crags that rim the crater. Then, suddenly and with deafening detonations, the jets rush together and convert the lake into a burning, seething, roaring mass, making a scene to which few others in the world are comparable.

Mauna Loa, on the island of Hawaii, and a neighboring volcanic cone, Mauna Kea, both nearly 14,000 feet above the sea, are among the highest island mountains in the world. On

the other islands of the Hawaiian group there are volcanic mountains scarcely less interesting. The crater of Haleakala, in the summit of East Maui, 10,000 feet above sea level, is one of the largest extinct craters in the world and is as well preserved as if its fires had been extinguished but a few years, instead of perhaps several hundred years ago.

The active volcanoes of Hawaii give a wonderful demonstration of the processes by which all these island mountains have been built up from the great depths of the ocean. Since the days of Captain Cook, geologists and others who are interested in the problems of volcanoes have visited the Hawaiian Islands and written about them.

Near the base of these mountains of igneous rock lie fields of sugar cane, which are just now of special interest. They are supplied with water from mountain streams and from wells and drainage tunnels that tap underground supplies. The Geological Survey, in cooperation with the Territory of Hawaii, has for several years been studying the water resources of the islands with a view to increasing the amount of water available for use in irrigation, and therefore in the output of sugar and other crops.

Several publications giving information on special phases of these interesting islands will be sent free on application to the Director of the United States Geological Survey, Department of the Interior, Washington, D. C. Among these are Water-Supply Paper 318, "Water Resources of Hawaii, 1909–1911," by W. F. Martin and C. H. Pierce, and Water-Supply Paper 336, "Water Resources of Hawaii, 1912," by C. H. Pierce and G. K. Larrison. These papers deal mainly with stream measurements and kindred subjects but contain also much information of general interest. A paper on the water supply of one of the neighboring islands is also available—Water-Supply Paper 77, "The water resources of Molokai, Hawaiian Islands," by Waldemar Lindgren. This paper contains an excellent map of the island.

Professional Paper 88 of the United States Geological Survey, Department of the Interior, "Lavas of Hawaii and their relations," by Whitman Cross, presents a summary of our present scientific knowledge of the lavas of the islands. With the exception of the introduction the book is mainly technical. It contains 97 pages and includes an excellent map of the Hawaiian Islands and diagrams showing the composition of the lavas.

THE DIVISION OF GAS WARFARE OF THE WAR DEPARTMENT

By direction of President Wilson all the activities of the government concerned with manufacturing poison gas for war and experimenting in the work of devising new methods were transferred to the control of the War Department on July 1.

The entire gas experimental work will be under the direction of Major General William L. Sibert, who recently returned from France, where he commanded the First Division of the regular army, and was assigned as chief of a special department on gas defense.

President Wilson has signed an order transferring the chemical section of the Bureau of Mines of the Department of the Interior to the War Department in accordance with the President's decision that measures for the use of gas as a weapon of offense and defense should be coordinated under the War Department. Experiments on war gas and masks have been divided among several branches of the government, including the Ordnance and Medical Departments of the army.

The most extensive work has been conducted by the Bureau of Mines, which established a special chemical laboratory at the American University on the outskirts of Washington. About 1,700 American chemists have given the government the benefit of their advice, experience, and services in this work, and important results are predicted.

Among the chemists whose services have been utilized by the Bureau of Mines in its Chemical Section in the gas experimentation are Dr. William H. Nicolls of 25 Broad Street, New York, President of the General Chemical Company; Dr. F. C. Venable, of the University of North Carolina; Professor E. C.

Franklin, of Leland Stanford University; William Hoskins, chemical engineer of Chicago; Professor H. P. Talbot, of the Massachusetts Institute of Technology, Dr. Ira Remsen, president emeritus of Johns Hopkins University; Professor F. W. Richards, of Harvard; Dr. Charles L. Parsons, of the Bureau of Mines; Dr. Reed Hunt, of Harvard; Professor W. D. Bancroft, of Cornell; Professor A. B. Lamb, of the Havemeyer Laboratory, New York University; W. K. Lewis, Chemical Engineer of the Massachusetts Institute of Technology; Professor C. A. Hulett, of Princeton; Yandell Henderson, of the Yale Medical School, and Dr. F. B. Underhill, of Yale.

In a letter dated June 26 to Dr. Van H. Manning, chief of the Bureau of Mines, notifying him of the coordination of war gas experimental work in the War Department, President Wilson wrote as follows:

I have had before me for some days the question presented by the Secretary of War involving the transfer of the chemical section established by you at the American University from the Bureau of Mines to the newly organized Division of Gas Warfare, in which the War Department is now concentrating all the various facilities for offensive and defensive gas operations. I am satisfied that a more efficient organization can be effected by having these various activities under one direction and control, and my hesitation about acting in the matter has grown only out of a reluctance to take away from the Bureau of Mines a piece of work which thus far it has so effectively performed. The Secretary of War has assured me of his own recognition of the splendid work you have been able to do, and I am taking the liberty of inclosing a letter which I have received from him in order that you may see how fully the War Department recognizes the value of the services.

I am to-day signing the order directing the transfer. I want, however, to express to you my own appreciation of the fine and helpful piece of work which you have done, and to say that this sort of teamwork by the bureaus outside of the direct war-making agency is one of the cheering and gratifying evidences of the way our official forces are inspired by the presence of a great national task.

WAR ACTIVITIES OF THE U. S. COAST AND GEODETIC SURVEY

BY executive order dated May 16, 1918, the President transferred to the service and jurisdiction of the Navy Department for temporary use the Coast and Geodetic Survey steamers *Patterson* and *Explorer*, including their equipment and personnel other than commissioned officers. These vessels have been employed for many years in surveys on the Pacific coast and chiefly on the coast of Alaska.

Since the beginning of the war the work of this bureau has been almost entirely for military purposes. Five vessels, three on the Atlantic and two on the Pacific coast, have been transferred to the Navy, and about twenty-three per cent. of the personnel has been transferred to some branch of the military service. Of the remaining force most of the field officers are engaged in land or hydrographic surveys for the Army or Navy, and a large portion of the office force is employed in reducing and publishing the results thus obtained.

A very important part of the office work is the preparation and production of charts, coast pilots and tide tables for vessels of the Navy and Merchant Marine, including those operated by the Shipping Board, the Railroad Administration, the Coast Guard and the Bureau of Lighthouses. The officers of the Survey are trained in work of triangulation, precise leveling, astronomic work, hydrographic surveying and chart construction, and are particularly available for service as navigation officers in the Navy and for duty with the Corps of Engineers, the Artillery Corps and the Aviation Service of the Army.

MAGNETIC OBSERVATIONS

THE various parties sent out by the Carnegie Department of Terrestrial Magnetism and the United States Coast and Geodetic Survey, have all reported securing successful series of magnetic observations during the time of the total solar eclipse of June 8. Magnetic observations were made by the Coast and Geodetic Survey at Green River, Wyo., Mena, Ark., and Orlando, Fla. In addition data will be obtained from the various magnetic observatories of the Coast and Geodetic Survey.

The stations at which magnetic observations were made by the observers of the Department of Terrestrial Magnetism were: Goldendale, Wash.; Corona, Colo.; at an altitude of 12,000 feet; Moraine Lake, Colo.; Lakin, Kans.; Brewton, Ala., and Washington, D. C. At Lakin, furthermore, and at Washington, D. C., atmospheric-electric observations were made. Reports on the results obtained will be published in the September issue of the journal *Terrestrial Magnetism and Atmospheric Electricity*. At various universities also series of magnetic observations were obtained and data will likewise be furnished by the Canadian magnetic observatories.

The magnetic survey vessel *Carnegie* arrived safely at her home port, Washington, D. C., on June 10, where she will be put out of commission probably during the period of the war. During her cruise from Buenos Aires, Argentina, around The Horn to Valparaiso, Chile, Callao, Peru, thence through the Panama Canal to Newport News, she was in command of Dr. H. M. W. Edmonds; the other members of the scientific staff aboard were: Messrs. A. D. Power, Bradley Jones, L. L. Tanguy, J. M. McFadden, and Walter E. Scott.

SCIENTIFIC NOTES AND NEWS

Dr. Theodore W. Richards, Erving professor of chemistry and director of the Wolcott Gibbs Memorial Laboratory at Harvard University, has been made a foreign member of the Accademia dei Lincei, Rome. He has been elected an honorary member of the Royal Irish Academy.

Sir James Dewar has been awarded the medal of the Society of Chemical Industry in recognition of the conspicuous services which, by his research work in both pure and applied science, he has rendered to chemical industry.

The French Geological Society has awarded the Conrad Ealte-Brun prize to Professor Lawrence Martin, of the University of Wisconsin, for his studies on the glaciers of Alaska.

Dr. Victor C. Vaughan, of the University of Michigan, and Dr. George E. Crile, of Western Reserve University, have been promoted to the rank of Colonel in the Medical Corps of the National Army.

Dr. Leonard P. Ayres has been made a colonel and is attached to General Pershing's staff in France. Dr. Ayres has had charge of the statistical work of the War Department in Washington.

Captain Paul H. DeKruif, Ph.D. (Michigan), has been ordered to return to the United States for the purpose of making special investigations on gas gangrene. Captain DeKruif has been in France for some months studying at the Pasteur Institute in Paris. He expects to remain in this country for about three months, when he will return to France.

Supervisory authority over several of the largest explosive manufacturing plants in the country has been granted to Professor Arthur H. Hixson, of the chemistry department at the University of Iowa. He holds the position of consulting chemical engineer in the ordnance department.

Dr. Arthur Carleton Trowbridge, of the geology staff of the State University, for the past few months in charge of the work at Camp Dodge, has been called to New York to take a place on the national war work council of the Y. M. C. A.

Dr. Chas. W. Burrows, associate physicist of the National Bureau of Standards in charge of the magnetic section of that institution, has resigned and will take up the work of commercial research and consultation, with laboratories equipped for research on problems involving magnetic materials and apparatus located at Grasmere, Borough of Richmond, New York City.

Dr. Vern B. Stewart, of Cornell University, has accepted an appointment in the Bureau of Plant Industry, and is at present engaged in work on the pathological aspects of markets inspection of vegetables.

Mr. H. J. Morgan, of the General Chemical Company, has been transferred from the Delaware Works at Marcus Hook, Pa., to the main laboratories of the company at Laurel Hill, Long Island, where he will be chemist in charge.

Miss Mildred P. Stewart has resigned her position as instructor in physiology and chemistry at Pratt Institute, Brooklyn, N. Y., to take charge of the work of the Dutchess County (N. Y.) Public Health Association, with headquarters at Poughkeepsie, N. Y.

It is stated in *Nature* that the British minister of munitions, in agreement with the secretary of state for the colonies and the petroleum executive, has appointed a committee to inquire into certain matters relating to the production of fuel oil from home sources. The terms of reference are: "To consider the report which has been rendered by the Petroleum Research Department on the production of fuel oil from home sources, and to advise to what extent, and within what time, it should be possible under present conditions to carry out the proposals made in this report; and to consider the steps which have been taken by the Ministry of Munitions in this connection." The members of the committee are: Marquess of Crewe (chairman), Colonel A. Stirling, Major G. Collins, Engineer Vice-Admiral G. G. Goodwin (Engineer-in-Chief of the Navy), Sir Richard Redmayne (representing the Controller of Coal Mines), Sir Lionel Phillips (representing the Ministry of Munitions); secretary, Mr. G. C. Smallwood (Ministry of Munitions).

The British Army Medical Advisory Board, established in 1901 has been in abeyance since the beginning of the present conflict. We learn from the *British Medical Journal* that it has now been considered advisable to appoint a new advisory board somewhat differently constituted and with a smaller number of members. The Director-General, Lieutenant-General T. H. J. C. Goodwin, is president, and the other members are Major-General Sir Bertrand Dawson, Major-General Sir Berkeley Moynihan, Colonel W. H. Horrocks, Colonel Sir Robert Jones and Lieutenant-Colonel Sir Harold J. Stiles. Sir Bertrand Dawson, who is physician to the London Hospital, is a consulting physician with the British Expeditionary Force in France. Sir Berkeley Moynihan, who is surgeon to the Leeds Infirmary, is consulting surgeon to the Northern Command. Sir Robert Jones is the Inspector of Military Orthopedics, and Sir Harold Stiles, of Edinburgh is assistant inspector of Military Orthopedics for Scotland and was a member of the commission of inquiry in France. Colonel Horrocks, who was a member of the old board, again serves on the new board as sanitary expert. The secretary is Mr. A. T. Gann, who was the secretary of the old board. It will observed that the new board does not contain, as did its predecessor, representatives of the India Office and of the directorates of military operations and of fortifications and works.

Mr. D'Arcy Power has been appointed Bradshaw lecturer of the Royal College of Surgeons of England for the ensuing year.

The annual Halley lecture at Oxford University was delivered on May 28 by Sir Napier Shaw, director of the Meteorological Office. The subject was "The first chapter in the story of the winds

Dr. William Mecklenburg Polk, professor of gynecology and dean of Cornell Medical School, died on June 24, in his seventy-fourth year.

Albert McCalla, Ph.D., a past-president of the American Microscopical Society and of the Illinois Microscopical Society, died on June 6, aged seventy-two years.

Titles of articles upon physiological subjects, both plant and animal, which are not published in the regular journals devoted to such studies are solicited by the *Physiological Abstracts*. Authors may send titles to Dr. Withrow Morse, 2900 Ellis Avenue, Chicago.

Free public lectures have been delivered in the lecture hall of the Museum building of the New York Botanical Garden, Bronx Park, on Saturday afternoons, at four o'clock, as follows:

April 6. "How to prepare the soil for gardening," by Mr. J. G. Curtis.

April 13. "Vacant lot gardens," by Carl Bannwart.

April 20. "Tree-planting for forests," by Professor S. W. Allen.

April 27. "Home gardens," by Henry G. Parsons.

May 4. "Drug plants and their cultivation," by Dr. H. H. Rusby.

May 11. "How to grow fruits in limited areas," by Professor M. A. Blake.

(Exhibition of Flowers, May 11 and 12)

May 18. "Fiber plants and their cultivation," by Lyster H. Dewey.

May 25. "Women as gardeners," by Delia W. Marble.

June 1. "Diseases of garden crops and their control," by Dr. Mel. T. Cook.

June 8. "Insect pests and their control," by Dr. F. J. Seaver.

The following lecture course was given by the Illinois Audubon Society during March. March 9, Ernest Harold Baynes, Meriden, N. H., "Birds in the nesting season." March 16, Norman McClintock, Pittsburgh, Pa., "Moving pictures of wild birds and animals." March 23, Edward Howe Forbush, Boston, Mass., "How birds help to win the war." March 30, Louis Agassiz Fuertes, Ithaca, N. Y., "Birds and their conservation."

It is related in *Nature* that the staff of the Natural History Museum, London, has been of assistance to various public departments in connection with the war. The following are examples of some of the questions which its members have been asked to answer: (1) nature of some organisms which caused blocking up of certain sea-water pipes; (2) as to some mite-infested oats at the front; (3) application of a remedy for the rice weevil in connection with the disease of beriberi; (4) as to methods of destruction of bedbugs; (5) the identification of specimens of larvae found in drinking water; (6) nature of wood used in the construction of a propeller of a Zeppelin brought down in this country; (7) inquiries as to certain wood stated to possess luminous properties; (8) questions arising out of the Canadian commission to consider the alleged depredations of sea lions on the Pacific coasts of North America, in connection with the fishing and canning industries; (9) identification of certain animal forms of tinned food, such as Pacific lobsters, sardines or sprats; (10) the identification of poisonous fishes in the West Indies; (11) the sponge fishery in the West Indies, and (12) the introduction of reindeer and other animals into South Georgia.

The Osiris prize of the value of $20,000 was founded for the recognition of the most important discovery or work in science, letters, arts, industries, or generally anything for the public benefit. The prize has been held in abeyance since the beginning of the war, but the Institute of France has decided to make an award this year.

Professor Henry Chandler Cowles, of the department of botany at the University of Chicago, recently gave the annual address at Iowa State College for the national honorary societies Phi Kappa Phi and Gamma Sigma Delta.

The Royal Society of Canada recently closed its thirty-seventh yearly meeting at Ottawa, Canada. There was an unusually large number of papers presented in all sections of the society, including those in the mathematical, physical and chemical, as well as the biological and zoological sciences. Abstracts of papers and discussions are expected in a forthcoming issue of Science.

It is announced in *Nature* that Mr. W. B. Randall of Waltham Cross, has generously provided funds for the establishment of a new research post at the Rothamsted Experimental Station, and the committee has appointed Mrs. D. J. Matthews (formerly Miss Isgrove) to occupy it. Mrs. Matthews will devote herself to the study of some of the problems connected with soil sterilization as it is now being carried out in certain types of nurseries.

On the initiative of Professor Gradenigo stations of psycho-physiological research on the effects of aviation have lately been founded at Turin and Naples. They are chiefly intended for the examination of candidates for service as air pilots.

UNIVERSITY AND EDUCATIONAL NEWS

Congress has passed a vocational training bill which, carrying an appropriation of $2,000,000, provides for an elaborate system of educating soldiers in trades. It provides for the teaching of more than 300 vocations. While a soldier is undergoing training he is to

receive army pay; he is free to accept or reject the training.

DR. WILLIAM ALLAN NEILSON was installed as president of Smith College on June 13. Because of war conditions other educational institutions were not asked to send representatives.

B. R. BUCKINGHAM has been appointed head of a bureau of research which forms a part of the newly established college of education of the University of Illinois.

DR. A. R. BAILEY, assistant professor of engineering at the University of Michigan, has resigned.

DURING the past year Professor Leo F. Rettger, of Yale University, gave the course of lectures in general bacteriology at Wesleyan University which for many years was one of the regular courses conducted by the late Professor H. W. Conn.

DISCUSSION AND CORRESPONDENCE

MEADE COTTON

THIS name has been given to a new Upland long-staple variety representing the nearest approach to Sea Island cotton in length and fineness of fiber. The original selection was made in 1912 at Clarksville, Texas, in a field of a variety locally called "Blackseed" or "Black Rattler," but not the same as the varieties that have borne these names in other parts of the cotton belt. The possibility of securing from this stock an Upland variety that would rival the Sea Island in length and fineness of staple appealed very strongly to Mr. Rowland M. Meade, at that time an assistant in cotton breeding in the Bureau of Plant Industry, and his enthusiasm now appears fully justified by the results of the work that he began.

Three generations of progenies from select individuals had been raised and a superior stock had been separated before the sudden and untimely death of Mr. Meade at San Antonio, Texas, in June, 1916, at the age of twenty-seven. The new variety has been called Meade as a tribute of personal regard of his associates, and to commemorate his services as a plant breeder. Though his work ended at an age when men are supposed to be prepared only to begin such investigations, he had studied cotton intensively for more than a decade and had made notable contributions to our knowledge of the habits of the plant and to the breeding of superior varieties.

Brief statements regarding the Meade variety have appeared in the current annual reports of the chief of the Bureau of Plant Industry and of the chief of the Bureau of Markets. Tests of the strength and spinning qualities of the fiber have given favorable results, so that the possibility of substituting this type of cotton for corresponding lengths of Sea Island is definitely indicated. The length of staple equals or may slightly exceed much of the "mainland" Sea Island crop of Georgia and Florida, Meade fiber under favorable conditions being usually about $1\frac{1}{2}$ inches, seldom falling below $1\frac{7}{16}$, and sometimes attaining $1\frac{3}{4}$. There is little tendency to "butterfly," that is, to shorten the fibers at the base of the seed, which was one of the undesirable traits of the older long-staple varieties, such as Floradora, Sunflower and Allen.

When compared with Sea Island in adjoining rows or plots, the cultural superiority of the Meade cotton is clearly shown. It produces earlier and more abundant flowers, the bolls are nearly twice as large, a heavier crop can be set in a short period, and the fiber matures in advance of the Sea Island, all tending to avoid damage by the boll weevil. Even when a large proportion of the buds or young bolls are shed, as a result of severe weevil injury or other unfavorable conditions, the Meade rows often yield two or three times as much as the Sea Island. And since buyers are accepting the Meade fiber as practically equivalent to the Sea Island the advantage to the farmer is clear. Some of the 1917 crop of Meade cotton was sold for 73 cents on the Savannah market.

Substitution for the Sea Island is also facilitated by the fact that the seeds of the Meade cotton do not have a dense covering of fuzz like most of the Upland varieties, but are naked on the sides like the seeds of the Sea Island and Egyptian cotton, so that it is pos-

sible to use the roller gins with which the Sea Island growers are already equipped. The only difficulty arises from the fact that the Meade seeds average somewhat larger than the Sea Island, but this can be avoided by a slight modification of the ginning equipment.

Another consequence of the larger size of the seeds is that the percentage of lint is lower than with some of the Sea Island varieties, although the lint index, the number of grams of lint produced by 100 seeds, is higher. Thus a sample of Meade cotton with a lint percentage of 26.6 had a lint index of 5.45, while Sea Island cotton with a percentage of 30.7 had an index of 4.93. In addition to producing more lint per acre the Meade cotton produces more seed than the Sea Island, the increase being at the rate of about 250 pounds of seed for each 500-pound bale. In such cases the popular idea of the supreme importance of the lint percentage is clearly erroneous.

That the Meade variety was not produced by hybridization, but by the discovery and selection of a superior type already existing, is of interest in relation to heredity. Confusion is likely to arise, as already shown by unauthorized statements appearing in newspapers and agricultural journals, in which the Meade variety appears as a new early Sea Island cotton or as a hybrid between the Upland and Sea Island types. The usual reasoning in such matters is to assume that a variety like Meade must be a hybrid because the plant is like Upland cotton and the lint like Sea Island, but the uniformity of the Meade cotton at once places it in a different class from any stock known to have a direct hybrid origin.

The need of combining the superior fiber of the Sea Island or Egyptian types of cotton with the superior cultural characters of the Upland type has appealed strongly to breeders, and many attempts have been made to secure this result by hybridizing different Upland varieties with Sea Island or Egyptian sorts. Crossing is readily accomplished and the results usually appear promising in the first and second generations. Thousands of natural and artificial hybrids have been raised, compared, and selected, and progenies of such hybrids have been carried through numerous generations, but without finding any hybrid stock with a sufficiently uniform and stable combination of the desirable characters of the parental types to justify commercial planting. While it is doubtless true that need of uniformity is greater with cotton than with many other crops, on account of the industrial uses of the fiber, the failure to secure sufficiently stable combinations of characters from hybrids between widely different types may be significant.

O. F. Cook

Bureau of Plant Industry,
U. S. Department of Agriculture

INTERNATIONAL ZOOLOGY AND THE INTERNATIONAL CODE

Discussion of the famous Piltdown jaw has developed one of the best examples imaginable of evil due to a disregard for established rules of zoological nomenclature. The great interest shown in this specimen by men other than professional zoologists makes the case a particularly good one on which to base an earnest plea for universal use of the International Code without restrictions and evasions. Three comparatively late papers on the Piltdown remains are enough to cite in the present connection.

Miller,[1] in describing the jaw as the type specimen of a new species of extinct chimpanzee, called it *Pan vetus*. Pycraft,[2] in a totally adverse reply to Miller, attempts to set his readers straight in matters of nomenclature by the statement that "when Mr. Miller speaks of the genus *Pan* he means the genus *Simia*." Boule[3] in a review of Miller's paper in which he agrees with that author in every detail except nomenclature, uses for the chimpanzee the generic name *Troglodytes*.[4]

[1] Smithsonian Misc. Coll., Vol. 65, No. 12, November 24, 1915.

[2] *Science Progress*, No. 43, pp. 389–409, January, 1917.

[3] *L'Anthropologie*, Vol. 28, pp. 433–435, July–October, 1917.

[4] More expansive than Pycraft, he explains as follows: "Pour ceux de mes lecteurs qui ne serai-

Here we have three authors, writing about one specimen and using three generic names for the chimpanzee. The subject is further complicated by the action of a group of European mammalogists who have petitioned the International Commission on Zoological Nomenclature to fix the name of the chimpanzee by fiat, not as *Pan, Simia,* or *Troglodytes*, but as *Anthropopithecus*.[5] One of these zoologists, after making his recommendation to the Commission, does not wait for action by that body, but immediately proceeds to use *Anthropopithecus* when he has occasion to mention the chimpanzee in print.[6] Four generic names are thus current for this one ape. One of these names, *Simia*, is applied by Boule to the orang-utan, and the fiat petitioners ask that it be fixed on the same animal; but by some authors, it is correctly applied to still another primate, the Barbary ape.[7] Another name, *Troglodytes,* would mean to most people familiar with generic terms in zoology, past and present, either the gorilla, or a wren.

All this confusion might be avoided if authors would observe the rules of the International Commission on Zoological Nomenclature and use the correct names for these anthropoids, *Pan* for the chimpanzee, *Pongo* for the orang-utan, and *Gorilla* for the gorilla. These names are now well known, and are entirely free from ambiguity.

N. HOLLISTER

ent pas familiarisés avec la nomenclature américaine, je dois dire que nos confrères des Etats-Unis ont récemment débaptisé, sans raisons bien sérieuses, les Chimpanzés et les Orangs. A leurs vieux noms latins, universellement connus et employés, de *Troglodytes* et de *Simia*, ils ont substitué les termes de *Pan* pour les Chimpanzés et de *Pongo* pour les Orangs, sous le prétexte que ce sont là les noms les plus anciennement donnés."

[5] *Zoolog. Anzeiger*, Vol. 44, pp. 284–286, May, 1914.

[6] *Kungl. Svenska Vet. Akad. Handl.*, Vol. 58, No. 2, pp. 18–27, 1917.

[7] Thomas, *Proc. Zool. Soc. London*, 1911, p. 125; Miller, "Mamm. Western Europe Brit. Mus.," p. vii, 1912; Elliot, "Review Primates," Vol. 2, p. 172, 1913.

HELPING TO STABILIZE NOMENCLATURE

TO THE EDITOR OF SCIENCE: In these days when there are so many workers in the science of entomology, and when many of the workers have had but little experience in the taxonomic side of the science and, therefore, do not realize its requirements and value, it is especially important that the periodicals should have certain definite, recognized policies, which will make it necessary for all authors to so make up their communications that they will contain at least the most of the important, although seemingly minor, details which are of great assistance to contemporaneous and future workers and tends to stabilize our nomenclature. With this in mind the Entomological Society of Washington has recently adopted the following rules and suggestions governing publication in their *Proceedings:*

Rule 1.—No description of a new genus, or subgenus, will be published unless there is cited as a genotype a species which is established in accordance with current practise of zoological nomenclature.

Rule 2.—In all cases a new genus, or subgenus, must be characterized and if it is based on an undescribed species the two must be characterized separately.

Rule 3.—No description of a species, subspecies, variety or form will be published unless it is accompanied by a statement which includes the following information, where known: (1) the type-locality; (2) of what the type material consists—with statement of sex, full data on localities, dates, collectors, etc.; and (3) present location of type material.

Rule 4.—No unsigned articles, or articles signed by pseudonyms or initials will be published.

Rule 5.—The ordinal position of the group treated in any paper must be clearly given in the title or in parentheses following the title.

Suggestion 1.—All illustrations, accompanying articles, should be mentioned in the text and preferably in places where the object illustrated is discussed.

Suggestion 2.—It is desirable in describing new genera and species that their taxonomic relationship be discussed, and that distinguishing characters be pointed out.

Suggestion 3.—In discussion of type material modern terms indicating its precise nature will be found useful. Examples of these terms are: type (or holotype), allotype, paratype, cotype, lectotype, neotype, etc.

Suggestion 4.—In all cases in the serial treatment of genera or species and where first used in general articles the authority for the species, or genus, should be given; and the name of the authority should not be abbreviated.

Suggestion 5.—Where the title of any publication referred to is not written in full, standard abbreviations should be used.

Suggestion 6.—When a species discussed has been determined by some one other than the author it is important that reference be made to the worker making the identification.

It is believed that nearly all workers will realize the importance of these or similar rules and it is hoped that other periodicals will carefully consider the matter and determine on definite policies. Such a step would be of great help to all workers and would assure a firmer foundation.

Rule 4 covers a subect which is often abused. When we consider that much of the cataloguing and indexing is now done by people with but little experience and knowledge, it is especially important that all communications should be properly signed.

S. A. Rohwer,
Corresponding Secretary-Treasurer

A NEW MARINE TERTIARY HORIZON IN SOUTH AMERICA

In preparing a monograph on marine Tertiary mollusca from the Lower Amazon region for the Serviço Geologico e Mineralogico do Brazil, we have been astonished to note that we are dealing with a horizon approximately equivalent to the blue marls of the Yaqui valley, Santo Domingo; the Bowden beds of Jamaica; the Gatun formation of the Isthmus of Panama, and the Chipola beds of Florida.

Carlotta J. Maury
Department of Paleontology,
Cornell University

THE PANAMA CANAL SLIDES THAT WERE

The big slides that blocked the Panama Canal after its opening were removed sufficiently about April 15, 1916, to permit ships to again use the waterway. The dredges continued at work, however, until they had not only brought the channel to its former size but, by April 1, 1917, had also made the part where maximum sliding occurred more than 200 feet wider than it was before the temporary stoppage of traffic. After January 1, 1917, only a little dredging was done, and by February 1, 1918, it was practically discontinued.

On August 30, 1916, a large bowlder slid into the channel and, because of its menacing position, caused navigation to be suspended until it could be blasted out. Because of its great hardness the rock was not completely removed until September 7, 1916. Since this 7-day interruption to navigation in 1916 the canal has given absolutely satisfactory and uninterrupted service.

Now that even dredging in the vicinity of the former slides, except a very little for general maintenance, has been discontinued for several months, it is interesting to recall an article published in the *New York Times* during the latter part of 1915, part of which follows:

> That uninterrupted service through the Panama Canal could not be expected for several years was the statement made last night by Professor Benjamin Le Roy Miller, Ph.D., who occupies the chair of geology at Lehigh University.

The article continues, quoting the professor directly:

> Before the canal can be said to be completed and permanently opened to traffic, the amount of material that must be taken out will not fall far short of the amount already taken from the Culebra cut.
>
> Transportation companies planning to use the canal should realize that they must not expect uninterrupted service for several years. During the dry season the canal may be opened, but it is certain to be closed during the rainy season when the earth is soaked with water and its movement toward the canal facilitated.

General Goethals, then governor of the Panama Canal, in his annual report for 1916

strongly condemns the professor's wild statements. The committee from the National Academy of Sciences, sent down by President Wilson about the end of 1915, also believed such assertions were not warranted by facts. Now the zephyrs of time have completely cleared away the foundations of fog on which the professor's off-hand, sweeping, and calamitous prophecy was based. One might pardon a professor of poetry for indulging in such dire and generalized prophecy regarding the canal, but that a professor of science should ascend so far into the rarified realms of imagination is surely an anomaly.

DONALD F. MACDONALD,
Formerly Geologist to the Isthmian Canal Commission

A COUNTRY WITHOUT A NAME

TO THE EDITOR OF SCIENCE: A statement made by one of your correspondents in SCIENCE, June 21, "Canada, which is no part of America," is barely saved by the context, "Canada, which is no part of America, as we wish it to be known, the U. S. A."

Wishes will hardly avail to rule that Canada is no part of America. The united states south of the Rio Grande bear the name Mexico; similarly the united states (provinces) north of the St. Lawrence and the Great Lakes bear the name Canada. Mexico and Canada are both good names, because they are single words and readily afford corresponding adjectives. The geographically intermediate group of states suffers the misfortune of having no name, and a much needed adjective is consequently lacking. All three groups are, of course, "of America"—Mexico being, however, rather more American than the other two.

The awkwardness due to lack of a name has been especially exhibited during the past year or more in such glaring inaccuracies as "American troops," "American supplies," etc., when "United States" is meant. That particular federation of American states which begins with Maine and ends with Washington needs a name more than it needs a national flower.

ELLEN HAYES

WELLESLEY, MASS.

SCIENTIFIC BOOKS

An Introduction to the Chemistry of Plant Products. By PAUL HAAS, D.Sc., Ph.D., Lecturer on Chemistry, Royal Gardens, Kew, and in the Medical School of St. Mary's Hospital, London; and T. G. HILL, A.R.C.S., F.L.S., Reader in Vegetable Physiology in the University of London, University College. With diagrams. Second edition. London, New York, Bombay, Calcutta and Madras, Longmans, Green and Company. 1917. $3.50 net.

The subject of paramount importance in biology is the study of the cell and its constituents. A great deal is known concerning the physical properties and occurrence of nearly all those bodies that possess definite forms under normal conditions. Independent of the biologist a large number of constituents have been isolated and these have been studied as to their chemical properties and in some instances their constitution has been ascertained. The work of the biologist and phytochemist has been usually conducted more or less independently. Up until now this was inevitable on account of the special training required in both these sciences. The time has come, however, when the results of the biologist should be understood by the chemist and the discoveries of the latter interpreted and applied to the study of the constituents of the cell. This work of Haas and Hill aims to supply this deficiency and is likely to be an incentive to the publication of other books covering these subjects.

This work deals essentially with the important plant constituents and includes: (1) Fats, oils and waxes; phosphatides; (2) carbohydrates; (3) glucosides; (4) tannins; (5) pigments; (6) nitrogens bases; (7) colloids; (8) proteins; (9) enzymes. These various substances are considered as to their occurrence in nature, their physical and chemical properties, microchemical reactions, method of extraction, quantitative estimation and physiological significance. The chemical methods of isolation of the plant products and their chemical reaction are very fully considered and for this rea-

son the work will be of special interest to the plant physiologist. The abstracts used in the preparation of the several monographs have been accurately prepared and the numerous citations to the original literature enhance the value of the work very much. If in courses of plant physiology it were required of the student to isolate all of these plant products it would add very much to the student's competence to deal with the nature of physiological processes and make this subject of greater fundamental value in its application to other phases of botanical work.

The second edition has been improved by re-writing the section dealing with the chemistry of plant pigments. This subject during the past few years has been the field of most interesting study by Willstätter and Miss Wheldale.

The value of the work would be much enhanced by a somewhat different arrangement of the subjects, particularly if they could be connected in their biological relations. To begin with "fats, oils and waxes," substances which are seldom studied in courses in either plant morphology or plant physiology, tend to discourage the use of the book by those for whom it would be a source of greatest benefit. On the other hand if a subject like the carbohydrates or pigments were first considered, both of which are under constant observation by the student of botany, it is quite likely that the chemical methods contained in the work would be applied in laboratory instructions. Furthermore the microchemistry of all of the plant products considered should be considerably improved upon. Many of the statements are only partly true; in others more pronounced reactions could be utilized while in still others a large amount of work should be included. To-day the interest in microchemistry or chemical microscopy is very great and with the appearance of such excellent works as those of Chamot, Molisch and Tunnmann there is an excellent basis in a work of this kind to connect the morphology of plants with the chemistry of the constituent and to follow physiological processes with microchemical reactions.

Henry Kraemer

June 1, 1918

SCALARIFORM PITTING A PRIMITIVE FEATURE IN ANGIOSPERMOUS SECONDARY WOOD

Professor Jeffrey, in his recent stimulating book, "The Anatomy of Woody Plants," Ch. VII., derives the vessel with the simple or porous type of perforation from the fusion of horizontal rows of circular pits in the end-wall, the scalariform pit and perforation being merely an intermediate stage in the process. Perhaps such a reversible evolution has gone on in certain groups, although it is here attempted to show that the available evidence is capable of the opposite interpretation.

Multiperforate and even uniperforate end-walls in gymnospermous vessels may arise from the fusion of circular pits with the dissolution of the closing membrane as Professor Jeffrey describes for *Ephedra;* but this fact seems inadequate to explain either the presence of scalariform pitting or the wide prevalence of scalariform perforations in the vascular elements of the less specialized angiosperms. It does not appear that all of the facts germane to the subject have been fully considered. In tracing out the development of vascular elements with uniperforated end-walls in accordance with Jeffrey's hypothesis, serious difficulty is met.

The scalariform pits in conservative regions of the secondary wood of *Liriodendron, Drimys, Asimina,* and other forms with prevailing circular pits in the less conservative regions, suggest antecedence of the scalariform condition, while a further illustration is afforded by the monocotyledonous *Dracæna.* Thus, in *Dracæna aurea,* typical secondary xylem without vessels is formed, the fibro-tracheids of which have circular pits in their lateral walls, but typical scalariform pits in the walls of the overlapping tracheid ends. There is no indication that such scalariform pits have arisen from the fusion of rows of circular pits. They are evidently a primitive feature of the tracheid and closely resemble the scalariform pits of the secondary wood tracheids of *Drimys* found in the vicinity of the pith; yet only a slight modification of the tracheids, with dissolution of the closing membranes and borders of the scalariform pits, would com-

plete transformation into typically perforated scalariform vessels.

It is evident that, to the extent that adjacent cells become specialized, and unlike in shape, in size, and in function, as, for example, the tracheal segment and an adjacent prosenchyma cell of the angiosperms, the scalariform pit must lose its alignment as an intercommunicating structure. Conversely, the circular pit is the more adaptable, and prevails in the vascular elements of more advanced plant families as typified by the Compositæ. Just as might be hypothesized, the scalariform pit *is relatively more common* in the vascular elements of less specialized families included in the Ranales. Probably the scalariform pit prevailed in the early angiosperms, and is even now being slowly discarded for the smaller circular pit. It was, in case of the vessels, first discarded on the lateral sides adjacent specializing tracheids, ray-cells, wood-parenchyma, or, especially, fibro-tracheids and fibers. The close relation between a vessel and the adjacent element or elements is evident from the fact that, for example, in *Cheirodendron* (Araliaceæ) four distinct types of pits communicate respectively with prosenchyma, wood-parenchyma, ray-parenchyma, and with other vessels. However, that the end-walls should preserve the more primitive sculpture is quite in harmony with the fact that adjacent cells are, in this case, alike. Complex modification is here unnecessary, and adequate comparisons of the secondary wood of existing *primitive* and *specialized* families proves the correctness of the view advanced. It is indeed a remarkable fact that in woods with scalariform perforations in the vessels, the prosenchyma usually bears distinctly bordered pits and is thus less distinct from the tracheal segment than in case of woods in which the vessels are characterized by the simple or porous perforations.

A feature of interest not mentioned by Jeffrey is the more or less frequent occurrence of branched bars. They occur occasionally in *Liriodendron* and other genera with scalariform perforations; but in *Cheirodendron* and some other araliaceous woods this branching of the bars in the perforation may become more or less intricate.

Comparison of such types with the scalariform wood of *Cycadeoidea Dartoni* has been suggested by Dr. Wieland, and for the purpose he has placed before me recently cut sections. The preservation of this fossil is perfect. The sections show the minutest detail in the pitting of the tracheids, even under a magnification of 450 diameters. The outline of the pits, the pit-apertures, and other minute characters are preserved in every detail. The sides and ends of these tracheids, in both tangential and radial aspects, are pitted with regular scalariform bordered pits, which at once remind one of those of *Magnolia*. Along with the true scalariform pits occur a few elliptical pits, and these are inserted between the long pits in such a manner that, by the dissolution of the borders and closing membranes, occasional branched bars would result. The resemblance between the pitting of these cycadeoidean tracheids and the vascular elements of *Magnolia* on the one hand, and of *Dracæna* on the other, is perfect, and may be followed out in minute detail.

The evidence in support of the hypothesis that scalariform pitting is primitive is convincing. It is evident that the process of the breaking up of scalariform pits into circular pits was in progress in the antecedent cycads, and that this process started first in the tracheid side-walls, whereby the overlapping tracheid ends became more conservative than their truly lateral portions. The complementary relations in the wood of the cycadeoids and cycads outlined in Wieland's recent note[1] are thus anatomically reconciled. The origin of branched bars is also explained.

Excellent examples to show that perfect scalariform tracheids exist in living types occur in *Magnolia hypoleuca*. The scalariform pitting very closely approximates that of *Cycadeoidea Dartoni*. Scalariform tracheids slightly more advanced may be found in the aquifoliaceous *Byronia sandwicensis* Endl. Here the tracheids retain typical sca-

[1] Wieland, G. R., Feb., 1918, "Cycadoid Wood Structure," *Science*, N. S., XLVII., pp. 141, 142.

lariform bordered pits at the overlapping ends, with the exception that occasional shorter pits are present and in a position to form branched bars should the pit membranes and pit borders be eliminated. The lateral walls show perfect transition from scalariform to circular pits. Living types, therefore, preserve all stages in the transformation of scalariform tracheids into vessels with multiseriate circular pits and simple perforations; and there is every reason to believe that modification is still going on.

Many seem to be under the impression that scalariform pitting is of rare occurrence above the cycads. A close comparison of scalariform tracheids, which Wieland's material makes possible, can leave no doubt that existing forms, in dicotyledons as well as in monocotyledons, still exhibit, in the vascular elements of their secondary wood, almost complete stages in the transformation of scalariform pitting into that of the circular multiseriate type, affording a valuable criterion by which to judge the relative primitiveness of angiosperm groups. The histologic evidence is fairly in accord with the floral evidence.

The exceptional abundance of circular pits in such forms as *Vaccinium corymbosum*, noted by Jeffrey, is accentuated by the fact that, in this type, the vessels are mostly isolated from one another and in contact with wood-prosenchyma which forms circular bordered pits in common with the vessels. Scalariform pitting occurs near the pith where, occasionally, vessels are adjacent. Here occur vessels showing perfectly the transition from scalariform pits to scalariform perforations, as well as the transition stages, noted by Thompson,[2] from scalariform to simple or porus perforations.

Forrest B. H. Brown
Osborn Botanical Laboratory,
Yale University

THE ORIGIN OF DICOTYLS

It is generally conceded that the origin of the conifers is from the evolutionary point of view a fairly luminous subject. Neither stem, leaf nor cone has wholly new or remote features. The group appears rather old mainly because so much of its history is known or directly inferable. Evidently, sporophyll consolidation into the hard spiny unisexual cones mainly occurred in the Permian, and by Jurassic time was complete. There is, thus, the distinct connection with the dominant Cordaites of the ancient world, and the cycads and *Ginkgo* amongst still existent types. Moreover, that *Ginkgo* was cosmopolitan, and of varied form in the Rhätic further broadens the possibilities of conifer relationship with known types, while by way of seed-ferns the several gymnosperm lines are in common carried back to Pteridophytes.

Not so the origin of dicotyls, long wholly without the range of scientific discussion. It was understood in a general way that the monocotyls did not obscure the problem. That they were either a contemporaneous or later development appeared more or less certain. Before the discovery of the cycadeoids, however, no line of attack from the viewpoint of either fossil or existent evidence seemed to carry the dicotyls beyond the Cretaceous. Back of that period the decipherable record ceased entirely. But the discovery that the cycadeoids were a varied group with flowers recalling those of magnolias, at once suggested that the origin of the dicotyls could not be wholly obscure. It was soon seen that the great extension of Magnoliaceous species in the lower Cretaceous must indicate a series of more primitive magnolias in the Jurassic. There might have been doubt as to the significance of the cycadeoid flower with its pollen-bearing synangium. But the reduced sorus of existing cycads plainly stood in the complementary relationship, just as did the cycadeoid microsporophyll and the carpellary leaf, as components of cycad fructification.

Nextly it was found by Nathorst and Wieland that the larger proportion of Mesozoic cycadales were cycadeoids, in part bearing small and reduced types of flowers. The *Wielandiella* of Nathorst with its slender bifur-

[2] Thompson, W. P., Jan., 1918, "Independent Evolution of Vessels in Gnetales and Angiosperms," *Bot. Gaz.*, LXV., pp. 89-90.

cating stems and Nilssonioid foliage proved the form of greatest interest; although very recently another related form, *Williamsoniella,* of quite equal interest from the Yorkshire coast has been reconstituted by Thomas. This has a very small perfect flower with somewhat scale-like microsporophylls, bearing, as it turns out, only a few pairs of sessile synangia. The stems are slender, and the foliage definitely Nilssonian to Tæniopterid This relationship was in *Wielandiella* somewhat obscured by a peculiar prolongation of the midrib.

Now this definite inclusion of *Nilssonians* amongst the small-flowered cycadeoids demonstrates the presence of a great alliance related to the primitive magnolias and abundantly represented in the leafy records of the Mesozoic. For it is seen that to this group must be added not only *Tæniopteris* but *Macrotæniopteris* at least in part. In 1905 I called attention to these foliar types in Monograph XLVIII. of the U. S. Geol. Sur. in the following justifiable terms:

> The genera *Nilssonia, Tæniopteris* and *Oleandridium* have now come to comprise numerous species of a very generalized and cosmopolitan type of leaf. As a consequence, it has become difficult, as always in such a case, to say definitely, in the absence of extended revision, where the one genus ends and the other begins. Nevertheless we have every reason to believe that at the one end of the series there are characteristic ferns analogous to such living forms as *Oleandra* and *Acrostichum,* as well as marattiaceous forms, and at the other an important list of cycadaceous forms. The closely related genera *Pterophyllum* and *Anomozamites* [now *Wielandiella,* in part] may be cited here. *Anomozamites minor* (Brongn.) Nath., as restored by Nathorst from specimens from the Rhätic of Scania, with its *Williamsonia*-like fructifications, *Nilssonia*-like foliage, and branching habit, is especially to be mentioned in this connection as one of the most interesting fossil plants known. This series is at the same time an exceedingly important one, covering as it does a period extending over much of the Paleozoic to the close of the Jurassic at least, a period so fertile in the evolution of higher forms.

From the Carboniferous to the Cretaceous there is, then, a great and cosmopolitan cycadeoid group with simple sparsely inserted leaves. This group is especially in evidence in the Rhätic, a period of marked change in the Mesozoic plant alignment. In the Northern hemisphere the Rhätic is generally notable for megaphyllous forms, especially so in the Richmond and North Carolina coal fields; but, as I found on the eastern side of the Andes in finely stratified Rhätic shales of Argentina, there are many small leafed and even scrub or upland forms. The small extent to which these forms showed netted venation is of course the weakest link in the chain of evidence for dicotyl derivation. But it may be recalled that the presence of net-veined forms [*Dictyozamites*] is not an inference; while the perfunctory reference of the numerous net-veined leaves of the Mesozoic to ferns, rarely found fertile, rests on no sound or certain basis. The great lyrate ferns of the Rhätic, *Clathropteris* and *Dictyophyllum,* are an exception; also an adumbration of the higher net-veined types soon to become dominant.

This subject has been considered more at length in a paper in the *American Journal of Science* (November, 1914). It is there suggested that polar stocks of unknown record may account in part for the seeming gap in the dicotyl leaf series. Also it should be noted that plastic, potent upland stocks (Bailey and Sinnott), are in the strictest sense of the word corollary to the main theory of radiation of animals and plants from the polar areas (Darwin, Forbes, Rütimeyer, Saporta, Joseph Dalton Hooker, Asa Gray in the Dubuque Address of 1875, Narthorst, Wallace, Scribner, Wortman, Wieland and Matthew). In any case the negative evidence indicates small flowers for the early dicotyls from the Permian on, and these are only likely to occur in some favored or unusual locality.

It has been said that the resemblances between Cycadeoid and dicotyl wood structure are deceptive, that some Magnolias (and the Trochodendrons) *have lost their vessels,* and that scalariform sculpture of the dicotyledonous vessel results from the lateral *fusion of circular pits* (Jeffrey). Even if the first of these contentions, improbable as this now seems,

were true, it no longer need be held vital. The second has been fully and thoroughly shown by Brown to be at variance with the facts. By the simple process of segmentation of the primitive and more fern-like scalariform pits, the circular-pitted and slit-pitted modern types of vessels must arise. When the scalariform cycads and the *Araucaria*, and Magnoliaceous (*Drimys*) seedlings are adequately compared, every stage in this fundamental change, which affords the very basis of dicotyl evolution, becomes visible.

Over and above the collateral evidence now at hand, three notable generalizations of the last few years further affect our conceptions of the fossil record of the dicotyls:

Firstly, there is a very small record of the upland vegetation of past times; although the enormous extent of the unknown upland record could not be surmised so long as the alternate emergence and subsidence of the continental areas remained wholly unmapped. Yet it appears that the high upland and polar, and not the tropic or coastal fringe plants have long included the great majority of plastic forms; and it is certain that upland and polar forms moved forward during the periods of continental emergence closing geologic epochs, and were least liable to extinction during medial subsidence. That is to say, we know best the aplastic coastal fringe forms with a broken record.

Secondly, the fossil record has gradually lengthened out in the case of so many lines both animal and plant, that a nearly universal parallelism comes into view instead of a comparatively recent development from constantly dichotomizing stocks. That is, slowly converging lines replace the "paleontologic tree" of the texts; and now that these persistent lines are more clearly discerned they are rapidly being pushed back still further on purely anatomical grounds. Thus it is not only easy to admit the view of Seward that the Araucariales are distinct, but it now seems difficult to show the connection of any of the gymnospermous groups since Carboniferous times. Their resemblances are all in large degree homoplastic.

Thirdly, Bailey has found much evidence for a progressive tracheidal shortening in all woody plants from the Carboniferous on. His fuller results are awaited with the greatest interest. The wonder is that it was not discerned long since that some such general course of change formed the basis of later stem evolution. Now this leads to a very obvious conclusion as to the origin of complexity of structure in dicotyledonous stems. Taking into consideration the observations already made as to the tracheidal origin of vessels, and the general dicotyl stem features, it seems that the main order of dicotyl stem change has been, beginning some time in the Permian: (*a*) shortening of the tracheids, (*b*) segmentation of scalariform into circular pitting, (*c*) pith reduction and development of both medullar and radial storage tissues, (*d*) secondary [relative] enlargement of short types of circularly pitted tracheids coordinate with [actual] reduction of adjacent elements to the condition of fiber tracheids, (*e*) progressive radial sclerotization, (*f*) development of extreme branching in sparse-leafed shoots. In recent interesting and serviceable descriptions of Lower Cretaceous woods by Stopes[1] exactly the older features agreeing with the course of change just outlined are sharply in evidence. In the Lower Cretaceous *Aptiana* the *small vessels* scarcely disturb the regular radial sequence, are little larger than the wood fibers, and nearly as elongate as normal tracheids. The medullary rays are similarly old of aspect, with considerable variation in cell length and size, the short rectangular form being almost cycadeoid. Fully in accord with the views advanced, scalariform wood is a striking feature in not only *Aptiana*, but several other Lower Cretaceous genera described by Stopes.

Morphologically speaking a point has therefore been reached where dicotyls are no more isolated than the conifers. From the viewpoint of stem, foliage and flower they are separated from other groups by no impassable gap. In fact the main categories of evidence for dicotyl origin are to be found within the

[1] *Brit. Mus. Cat. Mesozoic Plants*, 1915.

dicotyls themselves. Among various dicotyls, which have a Lower Cretaceous record and numerous present representatives, are not only the Magnoliaceæ and Trochodendraceæ, but Berberidaceæ, Myricaceæ, Salicaceæ, Fagaceæ, Moraceæ (figs), Lauraceæ, Myrtaceæ (*Eucalyptus*). The list might be greatly extended. As a clue to the nature of the real early characters of dicotyls attention may be turned to the sassafras, poplars, elms, oaks and magnolias, all typical in the Comanchian. All these must show recognizable archaic characteristics in the seedlings; and in making comparisons with gymnosperms, *Araucaria* and the cycads afford just as critical data as the cycadeoids.

G. R. WIELAND
YALE UNIVERSITY

SPECIAL ARTICLES

THE REGULATION OF BLOOD VOLUME AFTER INFUSIONS OF SOLUTIONS OF VARIOUS SALTS. PRELIMINARY NOTE

IN the recent work of Rous and Wilson[1] it was demonstrated that the disastrous effects of hemorrhage are not the result of the withdrawal of hemoglobin from the circulation. They bled an animal until the hemoglobin was reduced from 80 per cent. to 20 per cent., *i. e.*, three fourths of the original hemoglobin of the animal was removed without consequent serious effects. A reduction of four fifths, however, resulted in a somnolent, torpid condition, followed by death. Under the conditions of severe, sudden hemorrhage observed in man, the hemoglobin content is never reduced as much as these authors report.

Bayliss[2] has shown that the factor which makes the results of sudden hemorrhage severe is the lowered blood pressure consequent to the reduction of volume of fluid in the circulatory system. Bayliss and Rous and Wilson state that saline infusion is almost useless in sustaining blood volume; and Bogert, Mendel and Underhill[3] have shown in what a surprisingly short time infused saline solution leaves the circulation. Bayliss reports satisfactory results in sustaining blood volume when colloidal solutions of approximately the same viscosity as blood are used as infusion fluids. He used 6 per cent. gelatin or 7 per cent. acacia in Ringer's solution. Rous and Wilson have used the same solutions with the same satisfactory results. They also have used human plasma and horse serum. Human plasma has given them their best results. They dispute Bayliss's contention that the infusion fluid must have the same viscosity as blood. Hurwitz[4] has used Locke solution containing 5 per cent. acacia for infusion in human patients and reports satisfactory results.

In the course of some experiments of a somewhat different nature, the writer has had occasion to measure the rate of disappearance from the circulation of various isotonic solutions, each containing the same cation but a different anion. In view of the timeliness of this question of maintenance of blood volume, it seemed worth while to offer at this time what information was available which had a bearing on this problem.

The solutions examined were isotonic with rabbit's blood. The bromide, nitrate, acetate, chloride, sulfate and thiocyanate of sodium were the salts used. These solutions were injected into the jugular vein of rabbits which had been anesthetized with ether. Blood samples were taken from the carotid and the dilution of the blood after injection was followed by the hemoglobin percentage, using the Haldane technic. Fifty cubic centimeters per kilo body weight, or the approximate blood volume, was injected in two minutes. The average time for the blood volume to return to normal after the injection was less than an hour for every salt used except one. This exception was the sulfate. When this salt was used the blood volume did not return completely to normal during the entire experiment. The amount of infused fluid which remained in the circulation was about 9 per cent. of the amount put in.

[1] Rous and Wilson, *Jour. American Medical Association*, 70, 219.

[2] Bayliss, *Proc. Royal Society*, 89, 380.

[3] Bogert, Underhill and Mendel, *Am. Jour. Physiology*, 41, 189.

[4] Hurwitz, *Jour. American Medical Association*, 68, 699.

We can, then, confirm the results of Bayliss, Hurwitz and Rous and Wilson with chloride infusion; our experience supplements these in showing that, in so far as the bromide, nitrate and thiocyanate of sodium are concerned, the use of them in infusions after severe hemorrhage would probably be of little permanent value in maintaining normal blood volume. Furthermore, it is probable that employment of sodium sulfate, even in combination with colloidal substances, will prove little more efficacious than Ringer's solution.

Arthur H. Smith

Yale University

THE IOWA ACADEMY OF SCIENCE

The Iowa Academy of Science held its thirty-second annual session at the Iowa State College at Ames, beginning at 1:30 P.M. on Friday, April 26. After the general program in the Assembly Room sectional meetings were held for the reading of papers of special interest and these were resumed on Saturday morning. The general business meeting was held on Saturday morning at 11 o'clock. Dean E. A. Birge, of the University of Wisconsin, gave the annual address at 8 P.M. Friday, on "The warming of an inland lake." The Iowa Section of the Mathematical Association of America and the Ames and Iowa Sections of the American Chemical Society held their meetings in connection with the sessions of the Academy. President Ross delivered his presidential address on "The history of the teaching of science" at the general meeting on Friday afternoon.

At the business meeting on Saturday morning the following officers were chosen for the coming year:

President—S. W. Beyer, State College, Ames.

First Vice-president—T. C. Stephens, Morningside College, Sioux City.

Second Vice-president—R. Monroe McKenzie, Parsons College, Fairfield.

Secretary—James H. Lees, Iowa Geological Survey.

Treasurer—A. O. Thomas, State University, Iowa City.

Resolutions were passed endorsing the national administration, also calling for the selection of scientifically trained men to the position of fish and game warden and on the Board of Conservation.

TITLES OF PAPERS

Physics and Psychology

Temperature-time relations in canned foods during sterilization: George E. Thompson. Certain well-known mathematical formulæ are applied to heat penetration into foods packed in cylindrical cans. It is found that if the diffusivity of the food be known the temperature-time curves may be constructed with a fair degree of accuracy for cans of any size and for any practical temperature range. A number of experimental and theoretical curves are shown for squash and corn.

(a) Some structural features of selenium deposited by condensation from the vapor state above the melting point. (b) The sublimation curve for selenium crystals of the hexagonal system: L. E. Dodd.

Stroboscopic velocities in the tonoscope: H. R. Fossler and L. E. Dodd.

The eclipse expedition to Matheson, Colorado, June 8, 1918: D. W. Morehouse.

The X-ray spectrum of tungsten: O. B. Overn.

A new principle in the design of rheostats of large capacity: H. L. Dodge.

On the coefficient of absorption of photoelectrons in silver and platinum: Otto Stuhlmann, Jr.

On the production of opaque and the color of transparent and semitransparent metallic films: Otto Stuhlmann, Jr.

Hall effects in thin silver films: G. R. Wait.

The effect of pressure upon the conductivity of selenium: E. O. Dieterich.

The measurement of basic capacities in motor ability: Carl E. Seashore. The speaker reported having devised and standardized a series of seven tests for the measurement of the basic forms of motor capacity. These are (1) motor ability, (2) timed action, (3) a simple response to a simple signal, (4) a simple response to a complex signal, (5) a complex response to a complex signal, (6) precision in action—direction, time, distance and force, and (7) strength and endurance.

He also reported having devised simplified forms of instruments for these measurements. The time measurements are all made by means of small attachments, used on a phonograph. The complex reaction to a complex stimulus (chain reaction) is made by means of a carrier contact to a typewriter; and the strength and endurance test is made by means of a new form of ergograph, taxing the muscles of the forearm.

Zoological and Allied Subjects

(a) Bird records of the past winter (1917–1918) in the upper Missouri valley. (b) A note on molluscan behavior. (c) Birds of Union county, South Dakota: T. C. Stephens.

An unusual example of incisor growth in the western fox squirrel: Dayton Stoner.

Pharyngeal derivatives of Amblystoma: Francis Marsh Baldwin. This paper deals with the morphogenesis of the thyreoid and thymus glands, the postbranchial and epithelial bodies of *Amblystoma*, beginning with larvæ 5 mm. long, and including stages in metamorphosis and adult. The thyreoid gland arises as a solid outgrowth from the pharyngeal floor and breaks up into scattered cells, which, by mitotic division, give rise to the thyreoid follicles, in which colloid appears in late larvæ. There is no evidence of the formation of accessory thyreoids. The thymus gland arises from five pairs of anlagen, derived from the dorsal margins of the corresponding gill pouches. The anterior two degenerate, the other three form the definitive organ. There are no ectodermal contributions to the gland. The postbranchial body arises from a thickening of the pharyngeal floor, behind the last gill-pouch. In all cases, with one exception, it was asymmetrical. At the time of metamorphosis two pairs of epithelial bodies arise from the ventral parts of the last two gill pouches. They are the homologues of the parathyreoids of the mammals.

Economic entomology and food conservation: R. L. Webster.

A list of the birds found in Marshall county, Iowa: Ira N. Gabrielson.

Notes on a wood borer: H. E. Jaques.

The influence of floods upon animals: D. M. Brumfiel. This paper is an analysis of the ways in which floods may affect animal life based upon observations made along Whitewater river in Fayette county, Indiana. Floods affect animal associations in two general ways, viz.: (1) by changing the habitats topographically, and (2) by changing the composition of the association without affecting the physical habitat.

Topographical changes may be brought about as follows: (1) the course of the stream may be directly altered, (2) the local character of the stream may be altered, (3) changes may be brought about in the flood plain.

Floods influence associations directly by: (1) destroying or removing forms already established and (2) providing a means of dispersal.

The life and behavior of the house spider: H. E. Ewing. Although the common house spider, *Theridion tepidariorum* K., is one of the most common arthropods observed about our houses no one in the past appears to have made a systematic and thorough study of its life and behavior.

The complete life history is given, and observations extending over a period of several years are here reported. Scores of individuals were observed daily for many months both in captivity and in their natural environment. The cocooning process is described and illustrated by figures. Notes on courtship, cannibalism, food habits, emotions, instincts and intelligence are given.

A preliminary list of the Acarina of Iowa: Albert Hartzell. But few lists of *Acarina* have been made in this country. In 1886, Professor Osborn and Professor Underwood published a preliminary list of the *Acarina* of North America. This list included 99 species and 28 genera. In the Iowa list here given 75 species and 55 genera are included.

The mite fauna of Iowa is in general very similar to that of Illinois, yet it is interesting to note that in the vicinity of Ames we find several of the northern forms. No records of sheep scab or human scabs have been noted in recent years. Sheep scab at one time occurred in this state, but due to the efficient work of the United States Bureau of Animal Industry it apparently has been eradicated.

Notes on the food of the yellow perch in Cayuga Lake: W. A. Hoffman. This paper consists of preliminary work relating to the food of the yellow perch, *Perca flavescens* Mitchill, which was done in the limnological laboratory of the department of entomology at Cornell University.

Twenty-one fish were seined on two days, June 25 and July 14. An examination of the stomach contents of these perch was then made. Crustacea, fish and fish eggs were found in the greatest numbers and volume. Of the Crustacea, Decapods represented by *Cambarus* were present in eight stomachs, while Amphipods which consisted mostly of *Gammarus* and *Hyalella* were in ten. Chironomids, Trichoptera and Odonata made up most of the insect food. Only two Ephemerida were found, whereas these insects often are the only food to be found in the perch. The remainder consisted of Gastropoda, Hydrachnida and Entomostraca.

The cranial nerves of the dogfish: Sally P. Hughes.

Spiders of the family Attidæ collected in the vicinity of Ames: I. L. Ressler.

Botany

The white waterlily of McGregor, Iowa: Henry S. Conard.

The classification of plants: Henry S. Conard.

(*a*) *An unusual black walnut.* (*b*) *An annual sweet clover.* (*c*) *Notes on the perennial mycelium of a few parasitic fungi:* L. H. Pammel. Calls attention to the perennial mycelium of *Ustilago striæformis, Plasmopara Viticola, Urocystis Agropyri.*

An ecological study of the weeds of some Iowa fields: R. S. Kirby. The relation of weight and number of weeds to soil moisture and rate of growth of crops with their weight.

The germination of some native Iowa and exotic tree seeds: L. H. Pammel and Charlotte M. King. A continuation of the studies presented last year on the germination and juvenile conditions of some Iowa oaks. This study considers the germination and morphology of *Juglans, Carya, Fraxinus, Tilia, Acer* and *Pyrus.*

The vegetative organs of some perennial grasses: Florence Willey. It is often difficult to recognize grasses when they are in their vegetative condition. This study considers the rhizomes and early leaf and culm characters of such grasses as *Spartina cynosuroides, Muhlenbergia mexicana, Phragmites communis, Poa compressa, Agrostis alba, Bromus inermis, Agropyrón repens, Agropyron Smithii* and *Sporobolus cryptandrus.*

Some anatomical notes on the plants of a prairie province: Ada Hayden. The study includes a discussion of the comparative anatomy of plants in dry situations like *Petalostemon violaceus, Liatris, Aster lævis, Gentiana puberula* and in moist situations and swamps of such plants as *Scirpus fluviatilis, S. validus, Sagittaria* and *Phragmites.*

Some phenological records of spring flowering plants of Henry county: H. E. Jaques.

The fern flora of northeastern Iowa: T. J. Fitzpatrick. This paper gives an enumeration of thirty-three species of ferns and fern allies occurring in a region of Iowa which is of great botanical interest. Each species listed is accompanied by notes on occurrence, habitat, frequency, distribution, etc.

The pollen and pistil in relation to the germination of the pollen in five varieties of apples: John N. Martin. This report deals with the conditions that control the germination of pollen, the structure and function of the stigma as related to the germination of the pollen, and the external factors that may hinder the efficiency of pollination.

The structure of the seed coat and its relation to the germination of the seeds of the two common sweet clovers: John N. Martin. This reports the results of investigation on the structure of the seed coat with the aim of determining the difference between the structures of the seed coats of hard seeds and soft seeds and just what structure prevents the entrance of water in case of hard seeds.

Cytological study of the abortion of the pollen in the Winesap: John N. Martin. This variety of apple in Iowa often fails to produce good pollen. The abortion of pollen in plants is considered indicative of hybridism. The aim of this work on the Winesap was to trace cytologically the steps in the abortion of pollen from the mother-cell stage until the flowers were mature.

The endosperm of Utricularia: Robert B. Wylie and Alice Yocom.

A miniature Vallisneria: Robert B. Wylie.

Notes on an introduced woodland flora: R. I. Cratty. An artificial grove planted in Emmett county in early days was left in such condition that an interesting woodland flora was introduced.

A study in cereal roots: R. O. Westley and A. L. Bakke.

Pioneer plants on a new levee IV: Frank E. A. Thone.

Eradication of the Barberry in the spring wheat sections of the United States with special reference to Iowa: I. E. Melhus.

Plants of southeastern Alaska: J. P. Anderson. This gives a systematic list with notes of about 425 species of plants collected in southeastern Alaska, mostly in the vicinities of Sitka and Juneau, during the years 1914 to 1917 inclusive.

(*To be concluded*)

James H. Lees,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, JULY 12, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE MAN OF SCIENCE AND THE PUBLIC[1]

AN APPRECIATION OF SPENCER FULLERTON BAIRD

NEVER are the limitations of language more keenly felt than when the attempt is made to depict a human life.

If I could create, in however small degree, in the minds of those who never knew him, some understanding of the spirit of unselfish devotion to service that animated Professor Baird, of his unfailing wisdom, his clear, comprehending intellect, his evident reserve power, his kindly interest in others, his quiet eloquence in conversation, his serenity of mind and purity of heart, I should be content.

But how impossible it is to give adequate expression to a life of such fulness as that of Professor Baird's. His biographers, one after another, lament their inability to describe in commensurate terms the simple grandeur of this man, and to set forth in proper proportions his achievements. Professor Goode, in one of his memoirs, as if in despair at the feebleness of language to accomplish such a task, says:

> Such a man has a thousand sides, each most familiar to a few, and perhaps entirely strange to the greater part of those who know him.

But Professor Baird was not many-sided in the sense in which that term is usually employed. No one who knew him would have thought of calling him versatile. All who have written of him unite in bearing

[1] Address delivered at the dedication of a memorial tablet to Spencer Fullerton Baird on the forty-fifth anniversary of the establishment of the United States Bureau of Fisheries, Auditorium of the National Museum, February 9, 1916.

testimony to the presence in him of the same sterling qualities of mind and heart.

He was a man of great physical and intellectual strength and endurance, possessing a well-ordered mind, with all its powers under perfect control, a realization, in truth, of Huxley's picture of a liberally educated man:

That man, I think, has had a liberal education, who has been so trained in youth that his body is the ready servant of his will, and does with ease and pleasure all the work that, as a mechanism, it is capable of; whose intellect is a clear, cold logic engine, with all its parts of equal strength, and in smooth working order; ready, like a steam engine, to be turned to any kind of work, and spin the gossamers as well as forge the anchors of the mind; whose mind is stored with a knowledge of the great and fundamental truths of nature and of the laws of her operations; one who, no stunted ascetic, is full of life and fire, but whose passions are trained to come to heel by a vigorous will, the servant of a tender conscience; who has learned to love all beauty, whether of nature or of art, to hate all vileness, and to respect others as himself.

I have been led to a choice of a theme for this occasion by the memory of a conversation, if that may be called a conversation where one talked and the other listened, which took place more than thirty years ago. Professor Baird then expressed his disappointment that more of the young zoologists of America were not taking up the study of groups of animals, thus making themselves authorities in some not too narrow field. Thus in time authoritative memoirs and monographs would be forthcoming based on our own fauna, valuable alone as contributions to knowledge, and sure to be of assistance in the solution of problems of vital importance to the welfare of the people. The disposition of American teachers, especially in the eastern universities, to interest themselves and their students exclusively in the biological fad of the hour was criticized, but, of course, not unkindly.

We were seated on the veranda of the Fish Commission residence at Woods Hole, and the murmur of a strong tide making to the eastward through the "hole" was in our ears. Since that quiet evening many tides have ebbed and flowed, and many biological fads have risen to flood and have ebbed away, bearing on their bosoms the wreckage of many rejected theories.

Assuming that as accurate a knowledge as it is possible to gain of the living forms that are found in our country is desirable, to what extent, if any, has the situation improved as it relates to those tendencies which disturbed the scientific and patriotic mind of Professor Baird nearly a generation ago?

Had he been on the same spot some twenty-three years later, when in 1907 a considerable number of foreign delegates to the International Zoological Congress, which met that year in Boston, visited Woods Hole, his feelings as an American zoologist could be imagined, when he heard, as many of us did, expressions of surprise from visiting European naturalists, that among all the American zoologists at Woods Hole, drawn as they were from a large number of the universities and colleges of the country, there were so few who had an authoritative knowledge of any part of the fauna of their country.

It is a significant fact that Professor von Graff, who at the Boston meeting was elected to the presidency of the congress for its next meeting, while in this country, made collections of turbellarians at Syracuse, Cold Spring Harbor and Woods Hole and, returning to his university, Gratz, published, four years later, an important paper on these American forms. This paper, beside giving descriptions of seven new genera and thirty-one new species and one new subspecies, contained much anatomical and morphological detail.

Out of the hundreds of young men who had been trained in our universities for research work, why had there not arisen at least one who had already become an authority on von Graff's specialty? Must America be rediscovered, and our birthright taken away from us? Is this failure on the part of American zoologists to become acquainted with their own fauna of a piece with the happy-go-lucky existence which we as a nation have been, and are, living, flinging in spendthrift fashion our great natural resources to the viewless air, whence they come back to us not again any more? Or is it due to the same tendencies which Professor Baird deplored? An answer is suggested by the following statistics, compiled from Dr. Cattell's valuable tables, which, unfortunately, extend back only to 1898: Of the 400 doctorates conferred by our universities for work along zoological lines, excluding physiological and paleontological titles, noted in SCIENCE for the years 1898–1915 inclusive, barely 6 per cent. deal with problems which involve the study of groups as large as a family; and of these there appear to be but two that are of monographic proportions.

The prosperity of the nation is in no small degree dependent upon the understanding and sympathy which exist, and are maintained, between the men of science and the members of our law-making bodies. A challenge might be issued to the leaders of scientific thought in our universities to explain why they have played so small a part in public affairs, and why they have had so little influence upon legislation affecting the health and welfare of the people. It is true that a considerable majority of our national legislators are men learned in the law, and, in consequence of their training, peculiarly unresponsive to new ideas, and disposed to judge things as they are; while the scientific man is inclined to judge things as they ought to be. Thus the scientific man is appalled at the great waste of our natural energy occasioned by the absence of uniform and suitable forestry laws, that would not only help to conserve what we already have, but would make provision for the future. He is inclined, somewhat sharply perhaps, to demand why the energy that is stored in our coal supply, and flowing in every running stream and tide-way has not been made the property of the whole people. He grows impatient under the bonds of the antiquated and chaotic system of weights and measures which we are wearing to our discredit as a supposedly enlightened people, and to our disadvantage in the accomplishment of our commercial enterprises and ambitions. He has difficulty in understanding the state of mind of the person who replies to suggestions that we rationalize the spelling of our words with ludicrous and conventional exhibitions of the skepticism of ignorance, which such suggestions invariably call forth. When he lifts his voice to advocate a change, it seems to him that he is simply a voice crying in the wilderness, for none of these things move the man of precedent, and, learning that even in this day people stone the prophets who would jostle them from the calm of things as they are into the apprehended turmoil of things as they ought to be, too often subdues his voice, and returns in disgust to his laboratory.

As I look over the titles of theses for doctorate degrees in biology, however, knowing that they must, in some fashion, reflect the activities of our biological leaders, I am led to wonder if the failure of science to influence legislation in the interests of the people is not to be charged to the propensity on the part of these leaders to shun the practical. Is there a hierarchy in science that frowns upon independence of thought and action in her sanctuary? That

can hardly be. Let the heads of departments of biological research in our universities then take heart, and not be afraid to follow the lead of Pasteur, who surely committed no violence upon science by undertaking the solution of practical problems.

Let us now turn to the consideration of Professor Baird, the man of science. If there are any who ask what his claims to the appellation, man of science, are, let them turn to the voluminous bibliography, of over one thousand titles, of his writings, one fifth of which are formal contributions to scientific literature. Two of these, his "Mammals of North America" and his "Birds of North America" (Vols. VIII. and IX. of the Pacific Railroad Reports) alone would secure a high place for their author among the world's great scientific men.

To this virtue of original productiveness in science was added signal ability as an organizer and administrator. When, in 1850, he was called from his position of professor of chemistry and natural history in Dickinson College to the position of assistant secretary of the Smithsonian Institution, the young professor brought with him his own private collection, around which, through his genius for organization, grew the great and priceless collections of the Smithsonian Institution and National Museum.

Professor Goode presents the following useful condensed outline of the principal phases of activity in the life of Professor Baird; phases, which, it will be observed, overlap in a complicated manner:

(1) A period of twenty-six years' (1843–1869) occupation and laborious investigation and voluminous publication upon the vertebrate fauna of North America; (2) forty years (1840–1880) of continuous contribution to scientific editorship; (3) five years (1845–1850) devoted to educational work; (4) forty-four years (1843–1887) devoted to the encouragement and promotion of scientific enterprises and the development of new workers among the young men with whom he was brought in contact; (5) thirty-seven years (1850–1887) devoted to administrative work as an officer of the Smithsonian Institution and in charge of the scientific collections of the government; twenty-eight (1850–1878) as practical executive officer, and nine (1878–1887) as secretary and responsible head; (6) sixteen years (1871–1887) as head of the Fish Commission, a philanthropic labor for the increase of the food supply of the world, and, incidentally, in promoting the interests of biological and physical investigation of the waters.[9]

It is in that phase of Professor Baird's life which is presented by his activities as fish commissioner that are to be found illustrations of practically ideal relations maintaining between science and legislation.

From the summer of 1863, when he first visited Woods Hole, he realized the importance of a thorough investigation into the causes of the decrease of the food fishes along our coast.

In 1870 he made a systematic beginning in this inquiry, $100 having been set apart for that purpose by the Smithsonian Institution, and the Treasury Department granting the use of a 30-foot sloop yacht.

Having thus demonstrated to his own satisfaction by personal investigation that a problem existed, the solution of which was of vital importance to the nation, and realizing that the necessary inquiries were beyond the resources of any private enterprise to carry on, he set about securing the support of the national government.

To this task he brought the great powers of his own natural sagacity, to which was added the experience of thirty years of productive scientific work, and nearly four decades spent in the administration of what had grown, under his management, to be a great museum whose activities had become world-embracing. Although it is said of

[9] Smithsonian Report for 1888, p. 83.

him that he could never be induced to make a public address, he spoke easily and fluently in the presence of a few, and with the pursuasive eloquence of simple and exact statement. He soon won interested supporters to his plan.

The following brief extracts from his correspondence, which are taken from Dall's valuable "Biography of Professor Baird," will, I hope, illustrate something of the simple directness of his method of bringing the importance of an inquiry into the causes of the decrease of food fishes to the attention of Congress.

The first is a letter addressed to the Hon. H. L. Daws, M. C., and bears the date December 15, 1870.

Dear Sir: In the accompanying communication I give you a memorandum in regard to the subject of the decrease of the fish of our coast; though I fear I have not expressed my ideas as satisfactorily as might be desired.

In reference to the mode of action to be adopted in regard to this subject I have prepared a resolution which I commend to your consideration.

If you feel inclined to take immediate action in regard to an appropriation to meet the cost of the necessary investigation I would suggest that an item be introduced in one or other of the bills in your hands, providing the sum of, say, five thousand dollars, or as much thereof as may be necessary, to be expended by the commissioner under the direction of the Secretary of the Treasury, in prosecuting investigations into the subject of food fishes of the Atlantic coast, with a view of ascertaining what remedy can be applied toward securing the supply against its present rapid diminution.

The investigation would have to be carried on at several points on the coast, for instance, the Vineyard Sound, the coast of Maine, the Bay of Funday and perhaps the coast of New Jersey; and require several years for their completion.

Yours truly,

SPENCER F. BAIRD

The following extracts are from a letter of date January 3, 1871, from Professor Baird to the chairman of the House and Senate Committees on Appropriations. They are chosen to show the judicious mingling of information which, as a scientific man, it was his especial province to impart to Congress, with facts touching upon certain practical interests concerning which members of Congress might be sensitive.

. . . During my visit of last summer to the Vineyard Sound and other maritime portions of New England, I was much impressed by the great diminution in the numbers of the fish which furnish the summer food supply to the coast, . . . as compared with their abundance during a previous visit in 1863. . . . The belief is everywhere loudly expressed that unless some remedy be applied . . . the time is not far distant when we shall lose, almost entirely, this source of subsistence and support. . . . The causes assigned are varied, . . . most disinterested persons, however, ascribing the scarcity to the use of nets of one pattern or another and the capturing of the fish on or near their breeding grounds before they have spawned; and urging vehemently the passage of laws for preventing or regulating the employment of nets or weirs.

State action has been invoked at various times for the purpose of securing a remedy for the evil in question; but owing to conflicting interests and the influence of powerful parties who are concerned in maintaining the present mode of fishing, little has been accomplished. . . . Before intelligent legislation can be initiated, however, and measures taken that will not unduly oppress or interfere with interests already established, it is necessary that a careful, scientific research be entered upon, for the purpose of determining what should really be done; since any action presupposes a knowledge of the history and habits of the fish, that, I am sorry to say, we do not at present possess. We must ascertain, among other facts, at what time the fish reach our coast, and during what period they remain; when they spawn and where; what is the nature of their food; what localities they prefer; what agencies interfere with the spawn of the fish; what length of time elapses before the young themselves are capable of reproducing; for how many years the function of reproduction can be exercised; and many other points of equal importance. . . .

Cod and mackerel are not concerned directly in this inquiry, as they are not captured to any great extent in pounds; but since they feed almost en-

tirely on other fish, their abundance on or near our coast depends largely upon that of the kinds mentioned in the beginning of this letter. . . .

With regard to salmon, shad and alewives, which run up into inland ponds and streams to spawn, the protective measures now enforced by State Legislatures while these fish are in fresh water are amply sufficient to secure their increase. There are, however, about forty species of food fishes, belonging almost exclusively to the salt water of the coast from the Bay of Fundy to the Gulf of Mexico which require the consideration herein indicated.

As a result of such quiet but convincing appeals to reason, based on a profound knowledge of the subject, and a full understanding of the results desired, many members of Congress became interested, and a bill which was drawn up by Senator George F. Edmonds and Professor Baird was passed by Congress in 1871.

The resolution which established the office of commissioner of fisheries required that the person to be appointed should be a civil officer of the government, of proved scientific and practical acquaintance with the fishes of the coast, to serve without additional salary.

The choice of the commissioner of fisheries was by the terms of the bill practically limited to a single man, Spencer F. Baird, assistant secretary of the Smithsonian Institution.

It is a fact worth noting that the primary conditions which made possible such public philanthropic work as that exemplified in the life of Professor Baird were secured by the gift to the people of the United States of the foundation whose purpose is "the increase and diffusion of knowledge among men," and which bears the name of the donor—the Englishman, James Smithson.

The scope of the Fish Commission's activities rapidly expanded, as may be seen from the following summary made by Professor Goode. It gives in brief form a synopsis of what the Fish Commission had become at the time of the death of its founder, Professor Baird.

The Fish Commission now fills a place ten fold more extensive and useful than at first. Its work is naturally divided into three sections:

1. The systematic investigation of the waters of the United States and the biological and physical problems which they present. The scientific studies of the commission are based upon a liberal and philosophical interpretation of the law. In making his original plans the commissioner insisted that to study only food fishes would be of little importance, and that useful conclusions must needs rest upon a broad foundation of investigations purely scientific in character. The life history of species of economic value should be understood from beginning to end, but no less requisite to know the histories of the animals and plants upon which they feed or upon which their food is nourished; the histories of their enemies and friends, and the friends and foes of their enemies and friends, as well as the currents, temperatures and other physical phenomena of the waters in relation to migration, reproduction and growth. A necessary accomplishment to this division is the amassing of material for research to be stored in the national and other museums for future use.

2. The investigation of the methods of fisheries, past and present, and the statistics of production and commerce of fishery products. Man being one of the chief destroyers of fish, his influence upon their abundance must be studied. Fishery methods and apparatus must be examined and compared with those of other lands, that the use of those which threaten the destruction of useful fishes may be discouraged, and that those that are inefficient may be replaced by others more serviceable. Statistics of industry and trade must be secured for the use of Congress in making treaties or imposing tariffs, to show to producers the best markets, and to consumers where and with what their needs may be supplied.

3. The introduction and multiplication of useful food fishes throughout the country, especially in waters under the jurisdiction of the general government, or those common to several states, none of which might feel willing to make expenditures for the benefit of the others. This work, which was not contemplated when the commission was established, was first undertaken at the instance of the American Fish Cultural Association, whose rep-

resentatives induced Congress to make a special appropriation for the purpose.[8]

This description of the Fish Commission, although written more than a quarter of a century ago, may stand as a description of the functions of the Bureau of Fisheries of the Department of Commerce to-day.

Thus it is seen that in conceiving the idea of the Fish Commission, Professor Baird not only prepared working plans to relieve an immediate and menacing situation, but, by that act, brought into being an organization which is itself a living and growing thing, and, now become a part of the governmental mechanism, grows with the nation's growth and contributes its own peculiar part towards the conservation and increase of the national wealth.

More than thirty years ago, our government, through the work of Professor Baird, had already furnished a lesson in preparedness that the civilized world recognized, applauded, and in large measure, copied for its own. The following appreciations of Professor Baird's achievements in this respect are taken from G. Brown Goode's "The Smithsonian Institution," Washington, 1897, p. 188:

In 1883, Professor Huxley remarked: "If the people of Great Britain are going to deal seriously with the sea fisheries, . . . unless they put into the organization of the fisheries, the energy, the ingenuity, the scientific knowledge and the professional skill which characterizes my friend Professor Baird and his assistants, their efforts are not likely to come to very much good."

"I do not think," he adds, "that any nation at the present time has comprehended the question of dealing with fish in so thorough, excellent and scientific a spirit as the United States."

The principal French authority, M. Raveret-Wattel, wrote: "Nowhere has government given so much enlightened care to the rational cultivation of the waters, and afforded such efficient protection and generous encouragement."

[8] Report of Smithsonian Institution for 1888, pp. 84–85.

The importance of Professor Baird's services to fishery economy are, perhaps, more fully recognized in Germany than elsewhere. At the first great International Fisheries Exhibition, that held in Berlin in 1880, the juries in their official report said: "We must thank America for the progress which fish culture has made during the past decade"; and the magnificent silver trophy, the first prize of honor, was awarded to Professor Baird by the Emperor.

On the same occasion the president of the German Fisheries Association designated Professor Baird as "the first fish-culturist of the world."

One of the functions of the National Academy of Sciences, which was incorporated by Congress in 1863, is that its members may act in an advisory capacity on scientific questions. It is an important principle that is here recognized, and the country should have benefited more than it has done by this opportunity to secure expert advice. There are some indications that more attention is to be given to this principle than has been the rule in the past. It is therefore timely to suggest that both scientific man and legislator study the history of the establishment of the commission to inquire into the fisheries problem, and to note the behavior of Professor Baird, the man of science, and of the legislators with whom he had dealings. There is to be noted on the one hand sincerity and the absence of self-interest, coupled with exhaustive knowledge of the subject in hand, and on the other an intelligent comprehension of the problem when stated by competent authority, and a genuine desire to improve conditions. Naturally there resulted from this combination practical legislation that has been of acknowledged benefit to the nation and to the world.

The friendly relations which grew up between Professor Baird and Congress may be seen from Professor Goode's charming description:

The power of his pursuasive suavity was never better seen than when in the presence of the com-

mittees of Congress before whom he was summoned from year to year to justify his requests for money to be used in the extension of his work. He was always received with the heartiest welcome, and these keen, bustling, practical men of business, who ordinarily rushed with the greatest of expedition through the routine of the day, forgot their usual hurry when Professor Baird was before them, and listened so long as he could be induced to talk, and not infrequently would wander from the business before them to ask him questions upon subjects which his remarks suggested.

A very practical evidence of their appreciation was the prompt action upon the bill, passed soon after his death, giving twenty-five thousand dollars to his widow in recognition of the uncompensated services which he had rendered as commissioner of fisheries.

The secret of Professor Baird's power rests at bottom on his entire unselfishness, and thorough preparedness. Of such a scientific man as he one could say, and of every scientific man one ought to be able to say, paraphrasing a celebrated letter to certain people of Corinth: He is not puffed up, seeketh not his own, rejoiceth in the truth, and hopeth all things.

Around the Smithsonian Institution as a nucleus are clustered the various buildings of the National Museum and Department of Agriculture. Whatever else they may stand for, they are, in an important sense, monuments of such work as that which Professor Baird performed when he enlisted the interest of Congress in scientific questions. With these examples of the generosity of Congress towards science before us it may be asked why take time to argue for an accomplished fact? It is true that a good beginning has been made, and no fault is to be found, so far as I am aware, with the relations which exist between the scientific bureaus of our government and Congress. The life and work of Professor Baird laid broad and secure foundations upon which others have builded well. But there exists between science in this country as represented by laboratories of research in universities and elsewhere, on the one hand, and our state and national legislatures on the other, a gulf that is but inadequately bridged. I remember seeing, a few years ago, in some of our periodical literature, remarks that were meant to be derogratory, about what the writers called "Washington science." Such deliverances were, of course, but little more than evidence of a certain state of mind; nevertheless they are an index of a gulf, or barrier, or unexplored middle ground, between science, as represented by some of our most talented investigators, and members of our law-making bodies who desire to be shown probable practical benefits that are expected to follow legislation which they are asked to favor. Professor Baird, through his own contributions to knowledge, won a place among the first American men of science. By his example and influence he opened up avenues of research and promoted investigations that led to the advancement of knowledge to a greater degree than any other American has done. Science under his direction suffered no loss of purity by being clothed in garments of utility and thus made attractive to minds not otherwise prepared to appreciate her charms. With men equipped as he was to bring before legislative bodies projects in the interests of the public, selfish interests, which thrive on the ignorance of the people, would have little effect in hindering wise legislation. With men like him to the fore unkind remarks, calculated to widen the breach between science and legislation, such as "impractical and visionary scientists," on the one hand, and "pork-barrel politicians," on the other, would not be made. They would not be made because scientific man and legislator would meet on common ground, and, understanding each other, would say to their fellows, and to the pub-

lic: Here is a man anxious to improve the condition of his fellows; listen to what he has to say.

Recent world events make it evident that it is going to become more and more necessary to the life of the nation to conserve all its natural resources, and to coordinate all the energies of the state so that the whole may become available for any contingency that can be foreseen, and that all parts work together with the least possible friction, and with highest efficiency in results.

For the proper realization of the development of an ideal life for our nation we must be taught by example. Do we not find in the life and character of this great American, in whose honor we are met to-day, a model and a type? He was thoroughly equipped, both by natural gifts and by patient industry, for the battle of life as it had to be fought out; and he devoted his great powers unselfishly and ungrudgingly to the service of the public. His was the preparedness of mind and heart that must be the ruling traits of the American of the future; of mind that will lead to the successful solution of such national and international problems as arise, without loss of dignity or undue waste of energy; of heart, that even the gates of ambition and selfishness can not prevail against it.

Professor Baird, and those members of the House and Senate who learned to understand his sterling worth, together taught the world a great economic lesson. May we not express the hope that their example will be followed in these times and henceforth; that our legislators get the inspiration and information that is to determine legislation from those who know, rather than from those who do not know, even though they may be able to adorn their ignorance with the charms of eloquence that move the multitude.

On the nineteenth of August, 1887, amid surroundings which were in large part the realization of his own thought and activity, in the residence building of the United States Fish Commission, at Woods Hole, Massachusetts, Professor Baird, man of science and servant of the public, died.

I remember the day and the hour. It was afternoon, and the tide was low. I recall a picture of a red sun hanging over Long Neck[4] and reflected in the still waters of Great Harbor, of sodden masses of seaweed on the dripping piles and on the bowlder-strewn shore; and there rises again the thought that kept recurring then, that the sea is very ancient, that it ebbed and flowed before man appeared on the planet, and will ebb and flow after he and his works have disappeared; and a singular, indefinite impression, as if something had passed that was, in some fashion, great, and mysterious, and ancient, like the sea itself.

And now, more than a quarter of a century after his death, we who knew him, and were in greater or less degree privileged to be associated with him, are met here to give visible expression to the reverent esteem in which we hold in memory the image of this pure and lofty character, and to our high appreciation of his life and labors for the public good.

Mr. Secretary: It is no small honor that you and I share to-day in having our lives for a brief moment fall under the shadow of the name of one of our country's greatest men.

My honor it is to present to the Bureau of Fisheries of the Department of Commerce, of which you are the official head, as the gift of his associates and followers, and in their behalf, this tablet to the memory of the founder and organizer of the United States Bureau of Fisheries, and first

[4] Now known as Penzance.

commissioner of fisheries, Spencer Fullerton Baird.

Edwin Linton
Washington and Jefferson College

OBSERVATIONS ON THE SOLAR ECLIPSE MADE BY THE CROCKER EXPEDITION OF THE LICK OBSERVATORY[1]

The preparations for observing the total eclipse, including the standardizing of the photographic plates by means of a standard lamp and the loading of the plate holders were completed Friday evening. The weather conditions were not promising Saturday morning, with the sky completely covered with clouds of medium thickness, and these continued throughout the day, except for a short break, which proved to be one of the most remarkable coincidences known to me.

The prospects for a clear sky were apparently hopeless during the long hours of waiting, almost up to the time of totality. Fifty minutes before the moon's shadow was due to reach us we noticed a thinning of the clouds near the western horizon. It seemed hopeless to expect that the rift would continue or reach the region of the sky that we were interested in, but it did.

A very small area of the blue sky free from clouds had the sun at its center exactly at the center of the total phase, and all other parts of the sky were clouded. This region cleared not more than a minute before the beginning of totality, and clouds again covered the sun less than a minute after the passing of the shadow.

All of the instruments and all of the observers were ready, and the program went through as planned. Goldendale is situated exactly on the central line of the eclipse path. Observations made by my colleague, Professor Tucker, at Mount Hamilton, several months ago, had shown that the moon was slightly ahead of its predicted place, and he estimated that the eclipse would occur twenty seconds earlier than the time set down for it in the Nautical Almanac. We accordingly allowed for this in our program, and totality began two seconds later than Tucker's predicted time. The observed duration, one minute and fifty-seven seconds, agreed perfectly with the Almanac data.

DARKNESS UNUSUALLY PRONOUNCED.

The eclipse was a very dark one, the darkest of the six observed by me. The reading of newspaper print would have been difficult under the open sky. The chickens retired as if for the night. They were heard to give the morning cock crows before emerging a few minutes later. It was probably the shortest night in all their lives.

The eclipse phenomena, both celestial and terrestrial, formed a spectacle indescribably unusual and magnificent. The solar corona was, of course, the center of interest. It seemed brighter than usual, and its general outline was more elongated than we had expected, in view of the fact that we are not far from sun-spot maximum.

The coronal streamers were visible two and one half solar diameters to the east and west of the sun, but scarcely more than one diameter to the north and south, and the outline form was approximately triangular, with the eastern steamers converging to a sharp vertex at their most easterly point and the western streamers diverging to the base of the triangle at the most westerly points. The photographs thus far developed confirm the naked-eye description and extend the east and west streamers out to more than three diameters.

The solar prominences were numerous and large, as we should expect at a time of great sun-spot activity, but these did not concern us greatly, as they can be observed well without an eclipse. However, the prominences contribute greatly to the interest of the photographs, as the arching of the coronal streamers around the prominences is conspicuous, leaving no doubt that the forces which produce the prominences are controlling the forms of coronal streamers in their neighborhoods.

A few of the twenty-six photographs, secured

[1] Press despatch revised by the author for publication in Science.

with cameras of focal lengths from eleven inches up to forty feet, have been developed, and the details of coronal structure were recorded with admirable sharpness, showing that the instruments were in good adjustment, and, what is equally important, that the earth's atmosphere traversed by the coronal radiations was in a tranquil state.

TEST OF THE EINSTEIN THEORY.

Four cameras of fifteen feet focus, using plates of 14 by 17 inches, recorded the brighter stars existing in the region immediately surrounding the sun, though *vastly further away*, with apparent success, but their examination and suitable study can not occur until many days after the plates reach home. It is hoped that the measured positions of the recorded stars will serve as a test of correctness or falsity of the so-called Einstein theory of relativity, a subject which has occupied a foremost position in the speculations of physicists and others during the last decade.

If Einstein's hypothesis represents the truth, then the positions of the stars on the plates should be affected during the action of the sun's gravitations upon the rays proceeding from the stars while the rays are passing closely by the sun on their way to the earth. The test as an eclipse problem has never been made before, and it may be the only satisfactory test known to physicists, but whether our work will contribute evidence of value remains to be seen.

The same four plates should contribute something of value as to the existence or non-existence of any known bodies, such as the hypothetic planet Vulcan, in the vicinity of the sun. We expect to find no strange objects in the region commanded by the plates, and that the evidence will be wholly negative, but such comments have no weight a present.

Two spectographs were successful in their purpose of recording images of the stratum of green coronium gas enveloping the sun. This stratum is relatively thick over the east and west areas of the solar surface, but thin over the polar regions. The distribution of coronium is very irregular. The accurate position of the green coronium line can be determined with good accuracy from the images obtained with a three-prism spectrograph.

The general spectrum was recorded in good strength with two spectrographs. The evidences of polarized light are strong and definite on photographs obtained with two polarigraphs. Just what is the nature of the evidence which they will afford as to the composition of the coronal streamers will depend upon quantitative measures demanding time and discussion.

Four photographs were obtained by Miss Glancy, assistant in the National Observatory of the Argentine Republic, for that institution, to serve as a basis for determining the total quantity of light radiated by the coronal structure. She has taken the plates with her for later development and study. It is possible that her results will be affected unfavorably by the clouds which extended close up to the coronal structure, and it is possible that some of our Einstein and Vulcan plates are similarly damaged.

We constantly revert in thought and speech to the remarkable coincidence which brought a very small rift in the clouds, the only rift visible in the entire sky centrally over the sun and corona during the three minutes—and the three minutes alone—which interested us.

The expedition was composed of Director and Mrs. Campbell, Astronomer H. D. Curtis, Assistant Astronomer and Mrs. J. E. Moore, and Foreman J. E. Hoover, of Lick Observatory; Professor E. P. Lewis, of the Department of Physics, University of California; Mr. A. H. Babcock, consulting electrical engineer of the Southern Pacific Co., San Francisco; Miss Leah B. Allen, instructor in Wellesley College; Miss Estelle Glancy, of the National Observatory at Cordoba, Argentina; Professor S. L. Boothroyd, University of Washington; Dr. Ambrose Swasey, of the Warner & Swasey Co., Cleveland; Dr. John A. Brashear, Allegheny, Pennsylvania; Professor Douglas Campbell, Stanford University; Dr. J. S. Plaskett, director of the Dominion Observatory, Victoria, B. C.

W. W. CAMPBELL

LICK OBSERVATORY

SCIENTIFIC EVENTS

INSTRUCTION AND RESEARCH IN INDUSTRIAL HYGIENE AT THE HARVARD MEDICAL SCHOOL

The Harvard Medical School is prepared to offer courses of instruction in industrial hygiene and facilities to investigate the problems of industry. This is made possible through the foresight and generosity of a group of New England manufacturers, who appreciate the importance of studying the diseases of occupation and improving the conditions of labor.

Boston and its immediate vicinity offers exceptional opportunities for work of this kind. Within a short distance are found a great variety of industries, and the school has the assurances of sympathetic cooperation through an advisory board of business men consisting of:

W. E. McKay, Massachusetts Gas Company and New England Manufacturing Company.
S. Harold Greene, Lockwood, Greene and Company.
Frank J. Hale, Saco-Lowell Shops.

The president of Harvard University has appointed a committee on industrial hygiene which is organized as follows:

Dr. David L. Edsall, professor of clinical medicine.
Dr. Reid Hunt, professor of pharmacology.
—— ————, professor of chemistry.
Dr. M. J. Rosenau (chairman), professor of preventive medicine and hygiene.
Dr. C. K. Drinker (secretary), assistant professor of physiology

Under present conditions instruction and research in industrial hygiene will center about three subjects, chemistry, physiology and medicine, and in these subjects new departments will be created. In addition to the new facilities so offered, courses will be developed in the pharmacological, sanitary and social phases of industry, supplementing the work of the school of public health. Fellowships and scholarships are available for those properly qualified.

Opportunities will be open to three separate groups:

1. Research workers.
2. Medical officers for large industries.
3. Inspectors of industries.

1. *Research Workers.*—Those who are properly qualified to carry on original investigations may begin at any time, and the facilities and the laboratories at the Harvard Medical School and the Massachusetts General Hospital, and the practical conditions in many large industries will be available for this purpose. The qualifications of the worker, the problem, and conditions of each research must be approved by the head of the department in which the work will mainly be done, and also have the sanction of the committee. Those who are properly qualified may matriculate for the degree of doctor of public health (Dr. P.H.).

2. Physicians who desire to prepare themselves to supervise the health of large bodies of work people may familiarize themselves with the diseases of occupation in the industrial clinic directed by Professor Edsall in the Massachusetts General Hospital. Courses will be offered in the physiology of the worker by Professor Drinker, in industrial toxicology and biochemistry by Professor Hale, and in the sanitation and hygiene of the worker by Professor Rosenau.

In addition, there will be lectures and practical exercises to be given by specialists in different branches of public health.

3. Through cooperation with the school of public health of Harvard University and the Massachusetts Institute of Technology, opportunity is afforded to those who desire to prepare themselves for the position of inspector of industrial establishments. The requirements of admission to the school of public health and the courses given will be found in the catalog, which may be had upon application. Those who comply with the requirements will be granted a certificate in public health (C.P.H.).

Women are admitted as candidates for this certificate and to all the opportunities outlined in this announcement with the exception that they will not be permitted to matriculate for the degree of doctor of public health (Dr. P.H.).

Research workers in Group 1 may take

courses offered in Groups 2 or 3, and other special arrangements to meet particular aptitudes will be authorized by the committee on industrial hygiene.

In view of the war conditions alterations in the above plans may become necessary. For information apply to Dr. C. K. Drinker, Harvard Medical School, Boston, Mass.

THE MEXICAN AGRICULTURAL COMMISSION

PROFESSOR WILLIAM E. RITTER, scientific director of the Scripps Institute for Biological Research, has under the date of June 29, addressed the following letter to Dr. H. M. Smith, commissioner of fisheries:

It gives me great pleasure to report that the official and professional commission of Mexico headed by Ing. Pastor Rouaix, Secretary of Agriculture and Development, concerning which we were advised some time ago by acting Commissioner Moore, has recently visited San Diego and vicinity and the Scripps Institution. The party came to this place after having made an extensive tour of Lower California. It now goes northward to Los Angeles and San Francisco, then through the Rocky Mountain and North Mississippi valley states to Chicago and Washington. Since, as you are aware, the maritime industries of Mexico are under the jurisdiction of Secretary Rouaix the party were rather specially interested in the Scripps Institution because of its oceanographic and marine biological undertakings, and its consequent close identification with the fisheries and kelp industries of this region.

In addition to a brief inspection of the "plant" of the institution the party was entertained at a luncheon in the Institution Commons, representatives of the San Diego and La Jolla Chambers of Commerce and the San Diego Canners being also guests.

The occasion was utilized for emphasizing the part which science is playing and in a larger measure may, and ought to, play not only in solving strictly technical problems common to the two countries, but in composing international questions of a racial, economic and political character.

Members of the commission, as well as guests from the neighborhood, entered heartily into the purpose of the visit as thus viewed, all expressing the hope that more intimate relations between the two countries through agencies of this sort may exist in the future than have existed in the past. Ing. Joso Duvallon, director of agriculture, was specially explicit in setting forth views and possibilities to this effect. There is so much of promise in efforts of this kind that it should receive wide interest and encouragement. The southwestern states of our nation, including Texas and California, are naturally more directly concerned than other portions of the country, southern California being the most vitally interested of all because of the Colorado River and the Imperial area, and the rapidly growing maritime industries.

There can be no doubt that I express the sentiment of all those, Mexicans and Americans alike, who met and exchanged views and courtesies while the commission was in this vicinity, that the government of the United States, either national or state, or both ought in the near future to take steps to reciprocate and extend the good work started by Mexico through this highly able commission.

I am sending a statement similar to this in import to President Benj. Ide Wheeler, of the University of California, and to Dean T. F. Hunt, of the college of agriculture of the university, and trust the sentiment here voiced will reach the Secretary of Agriculture at Washington, the Honorable David F. Huston.

ORGANIZATION OF CHICAGO TECHNICAL SOCIETIES FOR WAR WORK

REPRESENTING an effort to cooperate effectively and vigorously for war work, an important joint-war committee has been formed by representatives of technical societies centered in Chicago. The movement was started by the military committee of the Western Society of Engineers, and at the invitation of that committee several meetings have been held at the Chicago Engineers' Club. As a result the "War Committee, Technical Societies of Chicago," to quote the official name, was organized June 4, 1918.

The purpose of this organization is "to enable the technical societies of the Chicago zone to call into play the efforts of the members of the various societies herein represented as occasion may arise and to coordinate their activities in the most effectual manner to help win the war." It is not proposed to attempt any novel "stunts," but rather to place at the disposal of the United States government and other authorized agencies the combined

strength and resources of the Chicago technical societies for war work as need may arise.

The following member societies are cooperating in the new war committee:

Western Society of Engineers.

Structural Engineers' Association of Illinois.

Society of Industrial Engineers.

Illinois Society of Engineers.

Illinois Society of Architects.

The American Railway Engineering Association.

The Swedish Engineers' Society of Chicago.

Illinois Chapter, American Institute of Architects.

Chicago Section, American Society of Mechanical Engineers.

Chicago Section, American Institute of Electrical Engineers.

Chicago Section, American Chemical Society.

Chicago Section, American Institute of Mining Engineers.

Mid-West Section, Society of Automotive Engineers.

Illinois Association of American Society of Civil Engineers.

Chicago Section, American Society of Heating and Ventilating Engineers.

Chicago Section, American Society of Refrigerating Engineers.

Chicago Section, Steel Treating Research Society.

Chicago Section, Illuminating Engineering Society.

Chicago Chapter, American Association of Engineers.

Officers of the war committee have been elected as follows:

Chairman, F. K. Copeland.

Vice-chairman, W. L. Abbott.

Secretary, Edgar S. Nethercut.

Treasurer, William A. Fox.

The executive committee consists of F. K. Copeland, W. L. Abbott, William Hoskins, C. A. Keller, Charles E. Lord, C. F. Loweth, Isham Randolph and Richard E. Schmidt. The address of the secretary of the war committee is 1735 Monadnock Block, Chicago.

ENGINEER OFFICERS' TRAINING SCHOOL AT CAMP HUMPHREYS

The War Department authorizes the following statement from the Engineer Corps:

The Chief of Engineers, General William M. Black, announces that the Engineering Officers' Training Camp, scheduled to open about August 1, will be situated at Camp Humphreys, 17 miles south of Washington, on a plateau overlooking the Potomac River. Two thousand candidates for commissions as captains and first lieutenants will be trained under the same facilities provided for the 17,000 Engineer replacement troops now there preparing for over-seas service. These facilities include the ordinary military arrangements, and in addition some 15 special schools to instruct men on such operations as mining, quarrying, gas and flame defense, barbed-wire fortification, water supply and railroad communication.

The candidates for commission will become familiar with the work of all these schools and conclude their training with a course in sapper work, in order that they may be fitted to command sapper troops if necessary. Many of the candidates will come from civil life, a campaign being under way to interest men of technical training and experience.

Many applications for entrance to the training camp have been received. To examine these candidates, General Black has designated a traveling board, which will visit several of the larger cities and determine the physical and mental fitness of the applicants. This board will be headed by Major E. H. Williams, who will advise the candidates as to the dates on which they should appear in the cities to be visited for examination. Candidates for first lieutenantcies should be between 32 and 36 years old, and those for captaincies between 36 and 42. Traveling expenses to the camp will be allowed successful candidates. Those accepted before August 1 will be sent to the existing engineers officers' training camp at Camp Lee, Petersburg, Va.

SCIENTIFIC NOTES AND NEWS

The Geological Society of America will hold its next annual meeting at Johns Hopkins University, Baltimore, Maryland, during convocation week of next winter. The program to be presented will concern itself particularly with the relations of geology to the World War.

MAJORS WILLIAM J. MAYO and Charles H. Mayo, of the Medical Reserve Corps, have been appointed colonels.

PROFESSOR OLIN H. LANDRETH, head of the general engineering department of Union College until a year ago, when he received a year's leave of absence, has had his leave extended for another twelve months to enable him to accept civilian service with the Ordnance Department.

DR. WALTER T. TAGGART, professor of organic chemistry in the University of Pennsylvania, has been appointed consulting chemist at large for the Ordnance Department of the United States government with instructions to report for immediate service. Dr. Thomas P. McCutcheon, Jr., assistant professor of chemistry, has likewise been appointed to civilian service with the War Trade Board.

AT the commencement of Little Rock College the honorary degree of doctor of laws was conferred on Professor Horace Russell Allen, formerly professor of orthopedic surgery, Indiana University, now a major in the Medical Reserve Corps.

DR. WILLIAM COON, of Haverhill, has been appointed director of health and sanitation for the United States Shipping Board. He will have his headquarters at Philadelphia, and will have charge of health and sanitation in all the shipbuilding yards in the country.

MR. E. H. PAGENHART, hydrographic and geodetic engineer of the U. S. Coast and Geodetic Survey, has been transferred by executive order to the Corps of Engineers (Reserve) of the U. S. Army, with the rank of captain.

DR. CARL J. ENGELDER has left the University of Illinois to accept a commission as second lieutenant in the nitrate department of the Ordnance Department at Sheffield, Ala.

DR. LEO M. CRAFTS, Harvard Medical '90, Boston City Hospital '91, has been called by the Surgeon-General to undertake special work in neuro-psychiatry for the War Department.

IT is announced that the Founder's medal of the Royal Geographical Society has been awarded for the present year to Miss Gertrude Bell, for her important explorations and travels in Asia Minor, Syria, Arabia, and on the Euphrates, and the Patron's medal to Commandant Tilho, French and Colonial Infantry, for his long-continued surveys and explorations in northern Africa. The medals are to be struck in bronze instead of gold, owing to the shortage of gold, the balance of the value being given in war bonds. The Murchison grant goes to Mr. C. A. Reid for his maps of the Belgian Congo; the Cuthbert Peek grant to Mr. G. F. Archer for his surveys in East Africa; the Back grant to Captain Bartlett for his distinguished leadership after the loss of the *Karluk*; and the Gill memorial to Captain Cuthbert Christy, R.A.M.C., for his surveys and explorations in Central Africa.

E. R. MILLER, who received his Ph.D. in chemistry at the University of Minnesota in June, has been appointed research chemist of the Alabama Polytechnic Institute at Auburn, Ala.

AT Syracuse University Dr. E. D. Roe, Jr., John Raymond French professor of mathematics, has applied for and obtained leave of absence for the coming academic year in order to devote his entire time to research. At the same university Mrs. E. D. Roe, Jr., has been awarded the degree of doctor of philosophy. Her doctor's thesis is entitled "Interfunctional expressibility problems of symmetric functions." She is the first woman to take the doctorate in mathematics at Syracuse.

THE Harvard corporation has announced appointments to the Cancer Commission of Harvard University and Collis P. Huntington Memorial Hospital. Dr. Robert B. Greenough will act as director of the commission, and as surgeon in charge of the hospital staff. Dr. Channing C. Simmons will continue as his secretary, and with Dr. Edward H. Risley, will serve as surgeon at the hospital. Other members of the commission are: Dr. James H. Wright, pathologist, in charge of diagnosis service; William Duane, research fellow in physics; William T. Boyle, research fellow in

biology; Dr. Henry Lyman, research fellow in chemistry, and Clarence C. Little, research fellow in genetics.

At the annual meeting of the American Surgical Association, held in Cincinnati, June 6 to 8, under the presidency of Dr. Thomas W. Huntington, San Francisco, the following officers were elected: *President,* Dr. Lewis S. Pilcher, Brooklyn; *Vice-presidents,* Drs. George W. Crile and Edward Martin, Philadelphia; *Secretary,* Dr. John H. Gibbon, Philadelphia; *Assistant Secretary,* Dr. Francis T. Stewart, Philadelphia; *Treasurer,* Dr. Charles H. Peck, and *Assistant Treasurer,* Dr. Charles N. Dowd, New York City.

The sixteenth annual meeting of the South African Association for the Advancement of Science is being held in Johannesburg, July 8 to 13, under the presidency of Dr. C. F. Juritz. The presidents of the sectional committees are as follows: Section A, astronomy, mathematics, physics, meteorology, geodesy, surveying, engineering, architecture and irrigation: Professor J. T. Morrison. Section B, chemistry, geology, metallurgy, mineralogy and geography: Dr. P. A. Wagner. Section C, botany, bacteriology, agriculture and forestry: Mr. C. E. Legat. Section D, zoology, physiology, hygiene and sanitary science: Professor E. J. Goddard. Section E, anthropology, ethnology, native education, philology and native sociology: Rev. W. A. Norton. Section F, education, history, mental science, political economy, general sociology and statistics: Professor T. M. Forysth.

Roald Amundsen's ship *Maude,* in which he will attempt to reach the North Pole, left Christiania on June 28 for the north. Captain Amundsen will board the vessel at Tromsoe. Captain Amundsen plans to follow the Siberian coast eastward from North Cape. He hopes to make most of the trip by sail. The ship carries two airplanes in which the explorer will attempt to complete his journey to the pole.

The *Journal* of the Royal Geographical Society states that the Argentine corvette *Uruguay* left Buenos Aires on February 18 with a new staff for the meteorological and magnetic station on Laurie Island, to replace those whose time has expired. The chief of the Argentine Commission is Señor Ole Holm, who, together with another member, has already seen service on the island. Continuous hourly eye observations have now been maintained since March, 1903, at this the most southern observatory in the world.

The Wilbur Wright memorial lecture of the British Aeronautical Society was delivered in the Central Hall, Westminster, on June 25, by Professor W. F. Durand, chairman of the American Advisory Committee for Aeronautics, scientific attaché to the American Aviation Mission in Europe, and professor of mechanical engineering, Stanford University, U. S. A. The subject was "Some Outstanding Problems in Aeronautics."

Professor A. J. Andrews, of Tufts College, is lecturing at Cleveland. Under his charge for the Boston region the National Board of Historical Service has been giving well attended lectures on the geography and historical meaning of the war at Camp Devens and the dozen other Y. M. C. A. "huts" around Boston.

Under the terms of the will of James Douglas, former president of copper producing firm, Phelps, Dodge & Co., $100,000 is bequeathed to the American Institute of Mining Engineers for a scientific library. McGill University, Montreal, receives $50,000 for a dormitory, the Kingston General Hospital, Ontario, $100,000 and the Museum of Natural History here $100,000.

Announcement is made that the position of research assistant under the Ellen H. Richards Research Fund is available for women graduates properly qualified in chemistry. Further information may be obtained from the Department of Chemistry, Massachusetts Institute of Technology, Cambridge, Mass.

President Wilson by executive order on July 2 placed all sanitary and public health activities carried on by executive bureaus, agencies and offices created during the war under the jurisdiction of the public health service.

The order was promulgated to avoid confusion in policies, duplication of effort and to bring more effective results and unity of control. It does not affect the jurisdiction of the medical departments of the army and navy, or of the provost marshal general in the performance of health functions of a purely military character, nor is it designed to prohibit investigations by the Bureau of Labor Statistics of vocational diseases, shop sanitation and hygiene.

THE Department of the Interior authorizes publication of the following:

We, the undersigned, who are members of the commission duly appointed in accordance with the provisions of public resolution No. 21, Sixty-fifth Congress, hereby certify that Mr. Garabed T. K. Giragossian showed us on Saturday, June 29, 1918, a model embodying the principles of his invention known as the "Garabed." We found that the model was not in shape to run or develop power. The inventor admitted that he had no working machine and that he was merely explaining principles. We do not believe that his principles are sound, that his device is operative, or that it can result in the practical development or utilization of free energy.

Witness our signatures at Boston, Mass., this 29th day of June, 1918.

James A. Moyer, director, Massachusetts State Board of Education.

Edward F. Miller, Massachusetts Institute of Technology.

M. de Kay Thompson, Massachusetts Institute of Technology.

Edwin B. Wilson, Massachusetts Institute of Technology.

Charles L. Norton, Massachusetts Institute of nology.

THE Maryland Geological Survey, under the direction of the State Geologist, Edward B. Matthews, has issued volume ten of the general series which maintains the same high standards of material and manner of presentation established by the late Professor Clark. The present volume consists of a brief life of Dr. Wm. Bullock Clark, state geologist, 1896–1917, with a tribute to his work as a state official and two papers of general interest on the geography and the water resources of Maryland. The geography was written by Dr. Clark and represents a summary of the knowledge of the geology, physiography, climate, flora, fauna, natural resources and manufactures, accumulated during the twenty years of Dr. Clark's activity. The treatment is so arranged that the work will serve as a teacher's guide in presenting the geographic features of Maryland. Suggestions for physiographic and geologic excursions are given for the environs of each of the twenty-three county towns of the state. The Report on Underground Waters represents the results of several years of cooperative work with the U. S. Geological Survey. It includes complete discussion of the geological formations, precipitations, surface and underground waters, public water supplies, and sanitary conditions for Maryland, Delaware and the District of Columbia. The report is well illustrated with diagrams and tables giving detailed information.

AFTER being six months on the way a letter has been received at the University of Pennsylvania Museum from William B. Van Valin, leader of its John Wanamaker Expedition to the Eskimos. The letter was written early last October, and must have come out by the dog-sled mail which the government maintains to Point Barrow, where it has a post. This is the northernmost point in Alaska, and is about 600 miles from the North Pole, a few hundred miles west from Herschell Island. Van Valin reports that he will make his winter headquarters at Point Barrow, and has already commenced gathering specimens. What is of more importance he has begun taking phonograph records of the native Eskimos, recording their songs and stories. He also has a moving picture camera and is taking films of their native dances and occupations. He reports that there is enough important work on hand to occupy him a full year, although he had not expected to stay so long. The Eskimo collections on view at the university museum contain many specimens already sent down by Mr. Van Valin. They, in connection with others secured from various sources and to a great extent by Mr. Wanamaker's liberality, form the most representative Eskimo collections to be found in any museum in the world.

UNIVERSITY AND EDUCATIONAL NEWS

Mr. Hobart W. Williams has given to the University of Chicago property to the value of $2,000,000, the gift being in memory of his father, Eli Buell Williams, and his mother, Harriet B. Williams. Part of the income of this great gift goes toward the development of the school of commerce and administration at the university.

The late Sir George Hare Philipson has by his will bequeathed £2,000 to the University of Durham College of Medicine, Newcastle-on-Tyne, for the foundation of two Philipson scholarships to be awarded to the undergraduate of the college obtaining the highest marks at the M.B. final examination.

Dr. T. Brailsford Robertson, formerly professor of biochemistry and pharmacology in the University of California, has been appointed professor of biochemistry in the University of Toronto. Also, Professor J. J. R. Macleod, formerly professor of biochemistry and physiology in the Western Reserve University, has been appointed professor of physiology in the University of Toronto.

Dr. Elias J. Durand has been appointed professor of botany in the University of Minnesota. Dr. Durand was formerly an instructor at Cornell, but since 1910 has held a professorship in the University of Missouri.

Professor Henry Blumberg, of the University of Nebraska has accepted a position in the mathematical department of the University of Illinois.

Dr. F. S. Nowlan, of Columbia University, has been appointed instructor in mathematics in Bowdoin College.

DISCUSSION AND CORRESPONDENCE

BROWN ROT OF SOLANACEÆ ON RICINUS

Bacterium solanacearum, the brown-rot organism, was first described by the senior writer from tomato, potato and eggplant in 1896 and from tobacco in 1908, on each of which it causes a widespread and serious disease. In recent years, chiefly through the studies of Honing in Sumatra, this organism has come to be known as a parasite not restricted to the Solanaceæ but capable of attacking plants of various orders from Urticaceæ to Compositæ, including Leguminosæ (peanut, and indigo), Euphorbiaceæ (*Acalypha*), and Verbenaceæ (young teak trees). Since Honing's discoveries it has been determined in the United States to be the natural cause of a wilt of the peanut (Fulton and Winston) and of the common cultivated Tropæolum (Katherine Bryan). More recently Stanford and Wolf in studying its effects on tobacco in North Carolina have found it also on Southern weeds (*Ambrosia artemisiifolia, Eclipta alba*) and have successfully inoculated it into a variety of plants including *Croton* and *Euphorbia*.

To the already considerable list of natural host plants must now be added the castor oil plant (*Ricinus communis*) on which it has appeared to a discouraging extent in several localities in our Southern States (Georgia, Florida) where *Ricinus* has been extensively planted this year to supply lubricating oil for army needs.

The *Ricinus* plants wilt in various stages of growth, often early, the woody part of the stem being stained brown and filled with a gray or brown bacterial slime which when cultivated pure yields the typical colonies an agar poured plates, browns potato cylinders, reduces nitrates, blues litmus milk, and otherwise in media behaves like *Bacterium solanacearum* from other hosts. When cross inoculated to tomato shoots it wilts them promptly, browning the vascular bundles, filling them with the typical gray slime and hollowing the pith into bacterial cavities. With it we have also produced the bacterial wilt on tobacco.

Furthermore, by needle pricks, using a subculture from a typical colony on an agar plate, which was poured from the interior of one of the wilting tomatoes above referred to, we have not only produced the disease again on tomatoes but also have produced it on several other plants known to be subject to *Bacterium solanacearum, e. g., Datura stramonium, Im-*

patiens Balsamina and *Tropæolum majus.* There can be no doubt, therefore, as to the cause of the disease, and land on which any of the common Solanaceous plants have wilted should not be planted to *Ricinus*, unless it is known positively that the wilt was not of bacterial origin. Dwarfing is usually the first sign of the disease in seedling *Ricinus* plants.

ERWIN F. SMITH,
G. H. GODFREY
UNITED STATES DEPARTMENT OF AGRICULTURE,
July 1, 1918

CELLULOID LANTERN-SLIDES

LANTERN-SLIDES made by the simple process of merely drawing or writing with ink on thin sheets of celluloid are often useful in presenting to an audience simple diagrams and sketches, tabulated data, mathematical expressions, et cetera.

Some years ago Mr. E. D. Tillyer, one of my colleagues at the Bureau of Standards, told me of slides that had been made by tracing on sheets of gelatine, which were afterwards bound between plates of glass to keep them flat. I found these of great use in illustrating a lecture with diagrams that I copied from published articles—far more convenient than blackboard sketches or large paper charts. But the method is subject to three somewhat annoying defects:

(1) Continual clogging of the pen and spreading of the ink while tracing a drawing, (2) impossibility of making inconspicuous erasures, (3) necessity of binding each tracing between two sheets of glass. The first two defects were removed by substituting for the gelatine a less soluble material, the third by constructing a set of glass pockets into which the slides could be slipped.

A slide of simple character can be made by writing or sketching directly upon the sheet of celluloid, using an ordinary steel pen of proper fineness, with india or colored ink. More complicated drawings and diagrams from publications are most easily made by tracing. Mistakes may be erased by wiping with damp cloth or paper. For firm, smooth lines of uniform thickness the ordinary draftsman's tools are needed: straight edge, French curves, ruling pen, and compass pen. Very fine lines are produced by scratching the surface with a needle point. Although scarcely visible on the slide, these will show up black and sharp when projected on the screen. Typewriting directly on the celluloid also projects well.

Other transparent materials can, of course, be used instead of celluloid. Gelatine yields fairly good slides but is difficult to work because of its solubility. Even tracing cloth and waxed paper are usable; although their limited transparency produces a rather dark field, and the texture of the material shows plainly.

To fit the standard $3\frac{1}{4}$ inch $\times$ 4 inch lantern-slide cover-glasses the celluloid should be trimmed to $3 \times 3\frac{1}{2}$ inches. During the process of tracing, it is more convenient to have the celluloid somewhat larger than $3 \times 3\frac{1}{2}$ inches to allow sufficient margin for holding it against the original by means of thumb-tacks or a paperweight. The margins may be trimmed later, leaving the drawing centrally located on the slide.

A glass pocket to hold celluloid slides in the projecting lantern is easily made from two $3\frac{1}{4}$ $\times$ 4 inch lantern-slide cover-glasses. These are held apart by strips of card, 7/32 inch wide and somewhat thicker than the celluloid, pasted along the entire length of each short edge and along an inch or so at each end of one of the longer edges. The glass plates are bound together by strips of black paper pasted over the edges as in making an ordinary lantern-slide, except that the binding is omitted where the separating strips of card are absent. The longer edge that is entirely free from binding forms the top of the pocket; the central opening left in the opposite edge is for inserting a piece of card to eject the celluloid slide when it can not be shaken out. Both of the longer edges of each glass are ground smooth and are somewhat beveled on the sides that form the interior of the pocket, so as to facilitate insertion and removal of the celluloid. A small white lable in an upper right-hand corner serves as a thumb mark for guiding the lantern operator.

The edges of the glass are ground by rubbing upon a sheet of carborundum paper moistened with turpentine, or upon a metal or glass plate fed with carborundum and turpentine or water.

It will be found convenient to have a dozen or two pockets—as many as are likely to be used in a single lecture, and to letter them consecutively on the thumb labels. A large collection of slides will take up very little room and will weigh very little. To avoid scratching, it is well to keep adjacent slides separated by sheets of paper of the same size. Before a lecture one merely arranges the empty pockets in the order of their letters and inserts the slides in the order in which they are to be shown. ARTHUR W. GRAY

PHYSICAL RESEARCH LABORATORY,
THE L. D. CAULK COMPANY,
MILFORD, DELAWARE,
April 5, 1918

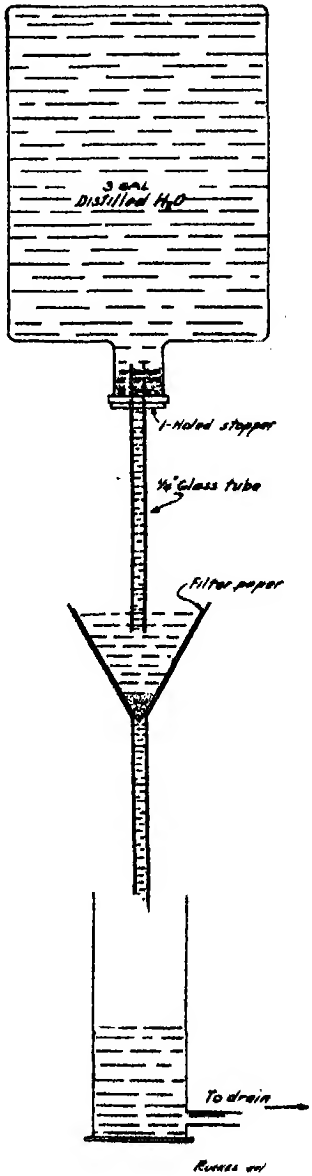
WASHING MICROSCOPIC ORGANISMS

One of the big hindrances to the study of plankton organisms is the difficulty encountered in manipulating these microscopic plants and animals during the first few steps of the technique. Hall (*Bot. Gaz.*, May, 1917) has outlined a method that the present writer has used for some years while at Cornell University. The problem of thoroughly and easily washing plankton material was one of the big features with which to contend.

For both diatoms and fresh-water crustacea the following procedure was found to be efficient:

1. Kill and fix the material in a mixture of
   Chromic acid .... one part,
   Acetic acid ...... one half part,
   Distilled water ... four hundred parts.
2. Wash by filtering through funnel.
3. Mordant in one quarter per cent. ferric alum for thirty minutes.
4. Wash again in funnel.
5. Stain in one half per cent. hemotoxylin for two hours.
6. Destain and wash as above.
7. Dehydrate by the glycerine method and mount, or
8. Dehydrate by the glycerine method and wash with 95 per cent. alcohol.
9. Ten per cent. Venetian turpentine, concentrate and mount.

The process of washing, originally, was to allow water to drip on the material that was held in a filter paper in a funnel. This may



seem an easy matter. However, several things have to be taken into account. Chief among these is to maintain a constant flow of water during the process. Frequently a prolonged

washing is necessary. Nearly everywhere the pressure in water pipes varies during the day and the night. Either the dripping may become so rapid as to flood the funnel and cause a loss of the organisms or the flow may cease altogether, leaving the material in an exposed condition and hence subject to drying. To overcome this trouble the following device was used.

Prepare a funnel and filter paper in the ordinary way. Then fill a two or three gallon bottle with distilled water and stopper it. The stopper should be a one-holed rubber one through which passes a glass tube of desired length but having an inside diameter of at least one quarter of an inch. Make the stopper very secure. Empty the organisms previously fixed, into the filter and then quickly invert the two or three gallon bottle; allow the tube to extend into the funnel so that the end of it is about a half inch below the edge of the filter paper. Give a good support to the reservoir. See the accompanying diagram for arrangement.

As filtration goes on the surface of the water in the funnel falls below the end of the tube that projects into it. This allows air to pass into the tube; the ascent of the air causes water to flow out of the tube and replenish the supply in the funnel. The flow continues till the surface of the water reaches the tip of the tube when the supply is automatically shut off. The process is continued in this way as long as there is water remaining in the reservoir. The descent of the water causes sufficient disturbance of the material in the funnel to prevent the organisms from matting against the side of the filter paper.

The rate of filtration and consequently the flow of water from the reservoir may be regulated by using various grades of filter paper or several sheets of a thin quality. The writer has found that a rather heavy grade of paper permits sufficiently slow filtration so that three gallons of water will last about fourteen continuous hours.

HERBERT RUCKES

ZOOLOGICAL LABORATORY,
GROVE CITY COLLEGE

AN OPTICAL ILLUSION WITH FATAL CONSEQUENCES

THERE is an optical illusion that has probably led, within comparatively recent times, to the death by drowning of scores, or even hundreds, of capable but inexperienced swimmers. A person swimming with the wind, and consequently with the waves which travel in the same direction faster than it is possible to swim, receives the impression of being carried backward by the water. In the absence of knowledge or information covering the case, most persons, so situated, if headed toward the shore, immediately think of "undertow," a word which nearly every one has heard, and believe themselves to be caught in an offshore current. The instincts of an untrained or half-trained swimmer always lead to a nervous haste and overexertion in deep water, even under conditions most favorable for swimming. When these instincts are supplemented by the panic that arises from the belief that the person is caught in an "undertow," the resulting increase of effort and acceleration of action reduces efficiency to a degree that must certainly have left many persons fatally exhausted before they reached a footing.

My attention was first called to this phenomenon through two cases of able-bodied but indifferent swimmers who, after swimming just beyond their depths in an onshore breeze at Pasay Beach, near Manila returned to the bathhouse in an excited state and reported having been caught in an "undertow" with nearly fatal result. In each case I made immediate investigation of the water at the point indicated and found neither "undertow" nor offshore current sufficient to embarrass any swimmer. Subsequently, on numerous occasions, while initiating beginners into deep-water swimming, being headed for shore with an onshore breeze, I have heard the initiate remark, with deep concern, that there was a current against us. This required to be accounted for. The feeling of being carried backward may be satisfactorily explained to most persons as arising in the same way as the effect commonly produced on a person

seated in a stationary railway coach when a train on an adjoining track moves forward. It would be more strictly comparable with the effect produced by two trains, one on each side of the stationary coach, moving forward at the same speed.

When this optical illusion receives due publicity in courses in physics, physiology and physical culture in our colleges, schools and gymnasia, there will be less danger attendent upon open-water swimming for tank-, pond- and river-trained swimmers who venture beyond their depths in larger bodies of water. And less danger will mean less loss of life.

It will be obvious to the reader that a swimmer should choose fixed objects by which to gauge his progress. But this is not the place for a discussion of the choice and use of such objects.

WALTER R. SHAW
UNIVERSITY OF THE PHILIPPINES,
MANILA, P. I.

SCIENTIFIC BOOKS

Flora of Bermuda. By NATHANIEL LORD BRITTON. New York, Charles Scribner's Sons, 1918. Pp. xi + 585. Illustrated. Price $4.50.

The geographic location of the islands forming the Bermuda archipelago, distant 666 nautical miles from Sandy Hook, 700 miles from Charleston, South Carolina, 736 nautical miles to Halifax and the island of St. Thomas 800 miles away, makes their flora of unusual botanic interest. Within two days' easy sailing distance from New York, the Bermudas have been favored by American tourists, who, leaving the rigors of a northern winter behind, step off upon land with a subtropic climate. No adequate account of the interesting flora has been available to the ordinary traveler interested in the native and garden plants of the islands. A number of lists have been published from time to time, but these are inaccessible and mostly out of print. The most noteworthy of these publications, useful for the identification of the plants, are the "Challenger Report on the Botany of Bermudas" (1884), by W. B. Hemsley; "The Botany of Bermuda" (1884), by J. H. Lefroy and "Plants of the Bermudas or Somers' Islands" (1885), by O. A. Reade. The want of a compendium of the flora of the Bermudas has long been a desideratum. The reviewer felt this lack very keenly on a botanic expedition to the islands in the summer of 1905 for the purpose of ecologic investigation. The plants collected there were named by the use of the Challenger Report, which he found incomplete and unsatisfying.

Dr. Britton, after a number of visits to the islands, where he had been ably assisted by Mrs. Britton and Mr. Stewardson Brown, has at last published the results of his field, herbarium and literary studies of the Bermuda flora. He acknowledges the assistance of native Bermudians, as also American botanists, who have elaborated special groups of plants. The Flora of Bermuda is a book attractively bound in a purple binding, representing the accurately matched color of Bermudiana, *Sisyrinchium Bermudiana* L., the Bermuda blue-eyed grass, which also appears as the frontispiece. The typography of the book leaves little to be desired and the illustrations, which represent line drawings of the principal species, will enable the botanically uninitiated to determine the plants, which are native and introduced. A useful bibliography is a feature of the book and the index comprises both common and scientific names. Much interesting information, not usually incorporated in manuals of botany, is included, and rightly so. We read, for example, on page 71 under *Lilium longiflorum* Thunb., that the "Easter Lily, White Japanese Lily, is extensively grown for export in a race (*L. Harrisii* Carr,) sometimes said to have originated here, but this industry is not as important as it was some years ago, although the Lily fields are yet a very conspicuous feature in the spring. The industry commenced about 1878 and reached its greatest development from 1890 to 1903." The research of Dr. Britton and his associates has enlarged considerably our knowledge of the botanic geography of the group. The native plants of Bermuda have originated from seeds, or other parts, brought from the American mainland, or the West Indies, by the natural

agencies of wind, ocean currents and birds. About 80 per cent. of the native land plants inhabit the West Indies, or southern Florida, or both. About 8.7 per cent. of the total native flora is endemic, there being 61 species in Bermuda, or its waters, not known to grow naturally anywhere else in the world. These plants are of the greatest interest to naturalists, as they presumably developed in Bermuda from related plants formerly existing but now mostly extinct there. Of the 61 endemic plants, 11 are flowering plants, 4 are ferns and the rest are flowerless species of mosses, lichens, fungi and algæ. The total number of native species known, those that have reached Bermuda independently of human activities, and have perpetuated themselves, including the endemics mentioned above, is as follows: flowering plants 146 species; ferns and fern allies, 19 species; mosses and hepatics, 51 species; lichens, 80 species; algæ 238 species; fungi at least 175 species. This makes a grand total of 709 species. The number of introduced and completely, or partially, naturalized species, those which have reached Bermuda through human activities, is about 303. It might be added in closing this review that all groups of plants are considered in the "Flora of Bermuda." The least satisfactory portions of the whole book are those dealing with the fungi and the diatoms (*Bacillarieæ*). The description of the fungi deals with much irrelevant matter. It would have been much better to have given what is actually known about the Bermuda fungi, than to have brought in a whole lot of interesting facts about the morphology and physiology of this group of plants, which can be found in the ordinary text-books of morphologic botany, but which do not apply especially to the flora of the group of islands under consideration.

JOHN W. HARSHBERGER

SPECIAL ARTICLES

THE RYDBERG UNIVERSAL CONSTANT N_0

IN connection with some work along related lines, the author has noticed that Curtis,[1] in his work on the Balmer series of hydrogen, reduced his measured wave-lengths to vacuo incorrectly. These wave-lengths were measured on the I. A. system, and hence at 15° C., 760 mm. pressure, while Curtis, for the reduction, used Kayser's Table of Corrections,[2] which applies only to the old Rowland system, founded on 20° C., 760 mm. pressure.

The error thus introduced, for any given frequency, is approximately $\frac{1}{}(n-1)_0\nu$ where n = index of refraction of air at 0° C., and ν is the frequency. For the spectral range of the hydrogen Balmer series, as well as of all the ordinary helium series $(n-1)_0$ varies by only 2 or 3 per cent. of itself. Thus to this approximation the error is proportional to the frequency.

Now the main object of Curtis's work was to test the accuracy of the Balmer formula, and to derive a more accurate value for the one undetermined coefficient (the Rydberg constant N_0) which occurs in this formula. The Balmer formula is

$$\nu = N_0\left(\frac{1}{4} - \frac{1}{m^2}\right),$$

where $m = 3, 4, 5$, etc. Since the error made by Curtis is fortunately a constant per cent. of the frequency (within 3 per cent.), it will not affect the accuracy with which the formula does or does not fit the series. It will change only the value of N_0. Curtis found that he must actually use the formula

$$\nu = N_0\left(\frac{1}{4} - \frac{1}{(m+\mu)^2}\right),$$

where $\mu = 69 \times 10^{-7}$ and $N_0 = 109{,}679.22$.

The error as given above amounts (in terms of N_0) to 0.50 for H_α, 0.513 for H_β, and 0.515 for the remaining lines. The correct value of N_0 is therefore 109,678.705, which agrees very closely with the value (109,678.6) determined by the author[3] by direct conversion from the Rowland system of the best previous measurements. With this value, Curtis's formula will fit equally well for all the hydrogen lines except H_α. For this line the (obs.-calc.) will be -0.0008 A, instead of $+0.0001$ A as given by Curtis. Since the error is only in N_0 and is

[1] *Proc. Roy. Soc.*, (*A*), 90, 605, 1914.

[2] Kayser's "Handbuch," Vol. 2, p. 514.

[3] *Astro. Jour.*, 32, 114, 1910.

the same for any series lying in the same spectral range, it will have no bearing on the controversy regarding the universal constancy of the Rydberg constant. For series extending far into the ultra-violet, this change of value may have some effect.

On Bohr's theory of the hydrogen atom, N_0 is a known function of the charge and mass of the electron, and of Planck's constant h. It is therefore important, on theoretical grounds, to know its value as accurately as possible. The author therefore wishes to emphasize that Curtis's own determination of the hydrogen lines, when handled correctly, leads to a value of this constant of 109,678.705, while the best previous determinations, when converted to the I.A. system, yield an almost identical value. It is hoped that future investigators will use 109,678.705 rather than Curtis's published value of 109,679.22.

Raymond T. Birge

Syracuse University,

MOISTURE RATIO

Much confusion has existed for years in interpreting the results obtained by various investigators on the determination of moisture in soils, rocks, etc. Noyes[1] has lately endeavored to bring about a more uniform method of reporting the moisture content of soils.

According to Bulletin No. 107, Bureau of Chemistry "Official Methods of Analysis," compiled by the association of Official Agricultural Chemists, the results of soil analysis are calculated as per cent. of the soil dried to constant weight in the water oven. It is rather unfortunate that the official method of reporting results has not been uniformly followed.

One of the phrases suggested by Noyes, "Ratio of water to 100 parts of dry soil," suggested to me the term moisture ratio. Such a term as "moisture ratio" on account of its brevity can be considered an advantage when preparing tables, charts, etc.; and if interpreted as defined below will not cause such confusion as the terms which have been used in the past.

The "moisture ratio" would mean the grams of water to 100 parts of the soil dried to constant weight at a temperature of 100–110° C. The terms "oven dry" or "absolutely dry" are being interpreted by some as meaning the drying of samples to 100° C., while others dry at higher temperatures and use the same terms.

The temperature at which samples are dried is seldom given in papers and as it is possible to control most drying ovens within a range of 10° C., the temperature of drying soil samples when using the term "moisture ratio" would be from 100–110° C.

I have lately made some tests on various electric drying ovens and found a wide range of temperature in some while others showed very little range on various shelves in the oven. The temperatures found on the various shelves in three of those tested are given in the table following:

TEMPERATURE RANGE IN VARIOUS ELECTRIC OVENS

Oven Number	Top Shelf	Middle Shelf	Bottom Shelf
1	96° C.	117° C.	147° C.
2	94	99	105
3	100	96	98

Oven No. 1 has the heating unit near the bottom of the oven and by tests made when empty as well as when full to capacity with soil samples showed a range in temperature of 51° C.

Oven No. 2 is similar to No. 1 except that an extra heavy piece of asbestos was placed above the heating unit leaving an air space of about ½ inch. Tests were made as with No. 1 and showed that the wide range of 51° C. was reduced to 11° C.

Oven No. 3 is a different make of oven, operating on a different principle from No. 1 or No. 2, but also had the heating unit near the bottom of the oven. From a large number of tests made under different conditions this oven never showed a range greater than 5° C. and most of the time it was only 1 or 2 degrees.

[1] "Reporting Moisture Results," H. A. Noyes, Science, N S., Vol. XLVII, No. 1212, p. 293.

The temperature at which soil samples are dried should be more carefully controlled and if the term "moisture ratio" were adopted we should have a more uniform basis of reporting results as well as of various analyses made by different investigators.

ALFRED SMITH
DIVISION OF SOIL TECHNOLOGY,
UNIVERSITY OF CALIFORNIA

THE IOWA ACADEMY OF SCIENCE. II

Chemistry and Agricultural Chemistry

Ames and Iowa Sections American Chemical Society

Iowa chemists and the war. A discussion: LEADERS: E. W. ROCKWOOD, IOWA SECTION, AND W. F. COOVER, AMES SECTION.

A consideration of some soil acidity methods: R. E. STEPHENSON.

Color effect of the furane nucleus: NELLIE M. NAYLOR AND RAEMER R. RENSHAW.

The determination of surface tension by the drop weight method: W. D. HARKINS AND F. E. BROWN.

The laboratory preparation of nickel carbonyl: J. S. COYE AND R. R. RENSHAW.

Studies of the gastric residuum III. The inorganic constituents of a composite sample of gastric residuum obtained from 70 apparently normal men, and their comparison with the inorganic constituents of a composite saliva sample obtained from the same individuals: CHESTER C. FOWLER AND JOHN H. BUCHANAN.

Studies of the gastric residuum IV. Amino acid nitrogen: RUTH B. CESSNA AND CHESTER C. FOWLER.

A study of over 70 twenty-four hour urine samples obtained from apparently normal women: ZELMA ZENTMIRE AND CHESTER C. FOWLER.

The relation of the composition of iron and mild steel to corrosion: J. S. COYE.

Methods for the determination of total nitrogen in soils containing rather large amounts of nitrates: R. S. SNYDER.

The number and action of molds in the soil: P. E. BROWN AND W. V. HALVERSEN.

The production of acid phosphate by composting sulfur and rock phosphate: P. E. BROWN AND B. J. FIRKINS.

The growth of legumes and the nitrogen problem: P. E. BROWN AND J. H. STALLINGS.

The nature of soil acidity: R. S. POTTER AND R. E. STEPHENSON.

The organic phosphorus of soil: R. S. POTTER AND R. S. SNYDER.

A study of certain green manure crops in making rock phosphate available in soils: ROSS L. BANCROFT AND B. J. FIRKINS.

A study of the comparative availability of different forms of phosphorus in nutrient solutions: ROSS L. BANCROFT.

The oils in cherry pits: NICHOLAS KNIGHT. An unquestioned source of oil in Germany in connection with the present war is cherry pits. The fruit is produced there in great profusion. We extracted the oils from 50 grams of the kernels of dried cherry pits and obtained 37.6 per cent. There were two varieties of oil. One, of which there was about 90 per cent., resembled almond oil, and the remainder seemed closely related to peanut oil.

Some problems of water supply for troops: JACK J. HINMAN, JR. A brief survey of methods which have been adopted at various times in the past for purifying water to be supplied to troops in the field.

The subject of chemical germicides is made the most important topic and particular attention is given to the use of chlorine and allied compounds. An extensive bibliography is appended.

The composition and digestibility of sudan grass hay: W. G. GAESSLER AND A. C. MCCANDLISH.

The occurrence and possible toxicity of molds in corn silage: ALVIN R. LAMB. The examination of a number of samples of corn silage, which contained mold which had grown in the interior of the silo, out of contact with air, showed the presence of two species, a red mold, *Monascus purpureus* Went, and a green mold, *Penicilium roqueforti* Thom. Aqueous extracts of the mycelium of these molds had no toxic effect on rabbits when injected intravenously. Large amounts of mold were given rabbits *per os* with no noticeable effect.

(*a*) *Deterioration of concrete silos due to the corrosive influence of silage acids.* (*b*) *Some observations on Kendall's method for the determination of iodine in thyroid preparations:* S. B. KUZIRIAN.

Some improved laboratory methods: W. S. HENDRIXSON.

Milk as the sole diet of ruminants: ANDREW C. McCANDLISH.

Experiments with soy bean meal as a substitute in the army ration: ARTHUR W. DOX.

Further work on acid potassium phthalate as a standard in volumetric analysis: W. S. HENDRIXSON AND SERENO G. NORTON.

Geology

Contributions to the geology of southwestern Iowa: GEORGE L. SMITH. The author did considerable work in this field during the past year. The paper is somewhat critical on the superficial work done in the past in this difficult geologic field but the author himself is more uncertain of the geology of this part of the state than he was twenty years ago.

Progress report on recent investigations of the Pleistocene in Iowa: GEORGE F. KAY.

(a) History of the investigation of the Pleistocene of Iowa. (b) Relation of the Wisconsin drift to the Iowan drift as revealed in Worth county: EMMET J. CABLE.

Interstate affinities of our coal measures: CHARLES KEYES. That the several coal fields of the Mississippi valley should remain so long without even approximate correlation of the different parts is one of the surprising features of American stratigraphy. Recent critical comparison of the terranal successions of the Eastern Interior Coal-field of Illinois and of the Western Coal-field of Iowa and Missouri reveals a parallelism having closer stratigraphic affinities than those displayed in Missouri and Kansas, which are in the same field.

Salient feature of Iowa's tertiary drainage: CHARLES KEYES. Of the many traces bearing upon the character of the preglacial drainage of the Iowa region the most noteworthy, perhaps, is the trend of the leading stream-lines at high angles to the present river courses. The Old Moingona river, for instance, the precursor of the existing Des Moines River, coincided only in its lower reaches with the present water-way. The ancient river was also a much more pretentious drainage-way than Des Moines River, and headed far away in the Black Hills.

Mountain-folding in the far north: CHARLES KEYES. The geological cross section exposed in the gorge of Athabasca River, near the northern extremity of the Rocky Mountains, is from a tectonic angle, one of the most remarkable on the North American continent. Insofar as the western world is concerned this section is unique in that it is the sole known expression of the fan-structure which so peculiarly characterizes the Swiss Alps. On Athabasca River only one half of the orographic fan is shown. On the opposite, or western, side of the Cordillera, along Frasier River, the pre-Cambrian slates, the dips of which are quite variable, portend the other limb of the fan.

Park sites along Des Moines valley: JAMES H. LEES. A number of geologically and scenically interesting localities along Des Moines valley which are suitable for state or district parks are described and illustrated.

The deepest well in the state: JAMES H. LEES. The well at Stuart, completed in 1916, is 3,121 feet deep, 111 feet deeper than the next shallower one, which is at Boone. It penetrates the New Richmond sandstone.

Some features of the Fort Dodge gypsum: JAMES H. LEES. Underlying the gypsum in some places is a fossiliferous conglomerate which probably has an important bearing on the age of the gypsum. Exposures of the gypsum under the drift show a remarkably irregular solution surface, whose age seems to be pre-Wisconsin. At one place the gypsum is heaved into mounds, evidently by expansion of the crystals through absorption of water. Solution channels are well shown here also.

A fauna from the Ste. Genevieve marls of Fort Dodge: A. O. THOMAS AND JAMES H. LEES. An interesting and very abundant fauna from red limy marls which have been classed as St. Louis, proves to belong to the Ste. Genevieve, which was formerly not known to extend into north-central Iowa. The fauna is largely brachiopods.

JAMES H. LEES,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, JULY 19, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

TRANSMISSION OF ACTIVATION IN PASSIVE METALS AS A MODEL OF THE PROTOPLASMIC OR NERVOUS TYPE OF TRANSMISSION

ONE of the most remarkable peculiarities of irritable living cells and cellular elements like nerve fibers is the readiness with which chemical or metabolic influence may be transmitted, without accompanying transfer of material, between regions differing in the degree or character of their physiological activity. Thus one region of a muscle or nerve which is in a physiologically more active or "stimulated" state transmits its activity regularly to another more or less distant resting region. The state of activity aroused in the irritable living system by a localized stimulus does not itself remain localized, but tends to spread; the region immediately stimulated imparts a similar state of activity to adjoining regions, these then activate the next adjoining, and in this manner a wave of activation or excitation is propagated over the entire irritable element, often to a long distance from its point of origin. In many cases, as in nerve, there is no decrease in the intensity of the local process as it passes along the element; its characteristics are reduplicated both qualitatively and quantitatively at each point which it reaches in its course; the local excitation is temporary and quickly dies out, each successive region of the tissue becoming active and then returning automatically to its original state of rest. Transmission of this type is known to physiologists as "conduction," and is exhibited in its most highly developed form in the nerves of higher animals. It is, however, by no means peculiar to these structures; any cell or cell element which reacts as a whole to a local stimulus illustrates the same phenomenon; some disturbance affecting the metabolism and functional activity of the living system is radiated from the original

point of stimulation and activates the whole. The characteristic functional manifestation then appears—contraction in a muscle cell, motor reaction in a protozoon, cell division and development in a resting egg cell, etc. Conduction is in fact a widely general if not universal cell process. Excitation may thus be transmitted not only between different regions of the same cell or cellular element but also between different cells or elements which are in contact with one another; the transmission between neurones in the central nervous system and from a nerve to its muscle or other terminal organ illustrates this type of conduction. It is thus possible to distinguish between intracellular and intercellular conduction, although there is probably no essential difference between the two types.

Physiological transmission of the kind described seems to have in it something mysterious and specifically vital; in fact the problem of the essential physico-chemical nature of nerve conduction—the type phenomenon of this class—is still regarded by most physiologists as unsolved, and apparently by many as insoluble. The difficulty of the problem has been accentuated by the apparent lack of any close analogies with known inorganic processes. Comparisons with the electric current, with the transmission of mechanical influences such as elastic strain or vibration, and with the propagation of explosive waves or of germ-effects like crystallization in supersaturated solution, have all proved inadequate and often highly misleading. Yet it would seem that any phenomenon which is so universal in organisms and upon which many of their most characteristic activities directly depend—especially in animals—must have some general physico-chemical basis present also in inorganic nature. The problem is to find some simple and readily reproducible inorganic process, involving transmission of chemical influence, which is similar in its most general features to the conduction process in living cells, initiated under similar conditions, and dependent upon the same fundamental factors. What is to be looked for is not complete or detailed identity of the physiological process with its inorganic model, but rather a class resemblance of a definite and unmistakable kind; the inorganic process should exhibit peculiarities which stamp it clearly as a phenomenon of the same essential kind as the physiological process. If the comparison is a true one, the transmission of chemical influence to a distance in cells or nerve fibers and the transmission of similar influence in the inorganic model should take place at similar rates, be influenced similarly by external conditions, be initiated by the same means, have the same external manifestations, and be dependent upon the same underlying physico-chemical factors. Just as the passage of the pulse wave in an artery and that of a distension wave in a simple elastic tube are both determined by general physical factors common to both objects, so the transmission of chemical or metabolic influence along a living conducting element like a nerve should—in the case of a valid comparison—depend upon certain fundamental features of physico-chemical constitution present also in the inorganic model. Is there in fact any known general class of non-vital physico-chemical phenomena to which we can thus assign the phenomenon of protoplasmic conduction?

In the stimulation of an irritable living structure by an external agent, the primary or releasing event is undoubtedly a surface process of some kind; the characteristic activation or "response" of the whole irritable element follows automatically upon this surface change. In most irritable cells any local mechanical or chemical alteration of the protoplasmic surface layer (or "plasma membrane"), or a slight change in its electrical polarization due to an electrical current, may cause excitation. There is little doubt, however, that the essential determining factors in any form of stimulation are *electrical;* and that mechanical and chemical stimuli excite the cell indirectly by means of the local electrical effects which they produce. The stimulating agent alters locally the structure or composition of the surface film; the state of electrical surface polarization is there changed; and the bioelectric circuit arising between altered and adjoining unaltered regions

completes the activation. This view at once explains why the electric current is the most universal stimulating agent. It is well known that stimulation of any cell, by whatever means induced, is always accompanied by an electrical variation of the cell surface, or current of action; and we find the same to be true of the propagation of the excitation wave. This last process, which is evidently essential to the stimulation of the cell as a whole, is apparently dependent upon the bioelectric circuit formed at the boundary between the active and inactive regions of the cell surface; that part of the local current which traverses the still inactive regions stimulates these electrically; the regions thus secondarily excited act similarly upon the resting regions next adjoining; the process repeats itself automatically at each new active-inactive boundary as it is formed, and in this manner the state of excitation spreads continually from active to resting regions. A wave of activation thus travels over the surface of the element.[1]

If this theory of conduction is well founded, the chemical alteration of a surface film of material under the direct influence of local electrical circuits would seem to be indicated as the essential basis for the transmission. Changes of this kind are in fact a frequent phenomenon at the surfaces of metals in contact with solutions; and in a recent paper[2] I have called attention to the many striking analogies between the effects of such local electrolytic action in metals and the effects of local stimulation in living cells. For example, in the rusting of iron in aqueous solutions the formation of local electrical circuits between different regions of the metallic surface is now generally recognized to be the chief factor in the process. The surface layer of metal is typically not homogeneous, but exhibits local anodal and cathodal areas; at the former regions the ions of the metal enter solution and are precipitated as oxide or carbonate, while nascent hydrogen and alkali are presumably formed at the cathodal regions. Each of the areas of local chemical action thus represents an electrode-area in a local electrical circuit; and electrolysis at these areas is what determines the chemical changes there taking place. Now electrolysis is a process in which the transmission of chemical influence to a distance without transfer of material is an essential and constant characteristic; the very flow of the current depends in fact upon this condition. Any electrochemical change at one electrode of a battery or other electrical circuit due to chemical action necessarily involves a corresponding change of a chemically opposite kind at the other electrode. Oxidation, the general effect at the anode, thus involves simultaneous reduction at the cathode; an oxidizing substance placed in contact with one electrode will thus instantly oxidize a reducing substance at the other electrode. Spatial separation of the two regions is a matter of indifference except in so far as it increases the electrical resistance of the circuit, thus retarding the rate of the electrochemical process. The transmission of the chemical influence between the electrodes is automatic and instantaneous.

This "chemical distance action"[3] suggests a possible basis for the protoplasmic type of transmission, since distance action is a feature of all electrochemical circuits, including those present in local action at metallic surfaces. If therefore it could be shown that the cell surface can act like a metallic surface the essential difficulties of the problem of protoplasmic transmission might be regarded as overcome. An inconsistency, however, appears in the fact that the transmission of electrochemical influence in a circuit is instantaneous (*i. e.*, 3×10^{10} cm. per sec.), while the most rapid protoplasmic transmission—in the motor nerves of mammals—is only 120 meters per second; again, the intensity of chemical distance action decreases with the distance between the electrodes, because of the increase in electrical resistance, while in the nerve impulse there is normally no decrease in intensity (or "decrement") as the local change

[1] *Cf. Amer. Jour. Physiol.*, 1915, Vol. 37, p. 348; 1916, Vol. 41, p. 126.

[2] *Loc. cit.*, 1916.

[3] *Cf.* Ostwald, *Zeitschr. physik. Chemie*, 1891, Vol. 9, p. 540.

passes along the fiber. Such difficulties are only apparent, however; in nerve conduction it is quite certain that an entirely new state of activity is aroused at each successive region of the fiber as the impulse passes; and all of the evidence indicates that the speed of transmission is determined mainly by the sensitivity and local rate of response of the nerve,[4] and not at all by the rate of transmission of the electric current in the bioelectric circuit. It is probable that in the local bioelectric circuit set up by the initial stimulus the direct chemical influence of the current extends for only a short distance, at most a few centimeters from the original site of stimulation; but one of its effects is to originate a new and similar circuit in the adjoining regions of the fiber; this process repeats itself as already indicated, and in this manner the impulse spreads. The observed speed of the activation-wave has thus nothing to do with the speed of the purely electrochemical distance effect. What we seem to observe is a local electrical circuit which travels along the nerve together with the activation wave; but in reality there is a succession of new circuits, each of which automatically arises at the boundary between resting and active regions as the front of the activation wave advances. The relatively slow rate of movement of the impulse and the absence of a decrement may thus be understood.

The rapid passage of a wave of chemical decomposition (probably oxidative in nature and involving some structural change) over the surface of the reacting element, followed immediately by a reverse change which restores the original or resting condition, is what appears to take place in a nerve or other living structure during conduction. Associated with the chemical process is a local electrical circuit by whose electrolytic action the chemical change is apparently determined. Have we examples of similar processes in inorganic systems? It appears in fact that this general type of process is not unusual in metals in contact with solutions. Especially clear and striking examples are seen in the transmission of the state of activity over the surface of metals, especially iron, which have been brought into the temporarily non-reactive or "passive" condition by immersion in strong nitric acid (or other suitable oxidizing agent) and are then placed in dilute acid and made to react. It has long been known that iron which has been thus "passivated" becomes resistant or refractory to reaction and (for example) no longer dissolves spontaneously when placed in dilute nitric acid (s. g. 1.20). But if while immersed in the dilute acid it is touched momentarily with a baser metal, or with a piece of ordinary non-passive iron, it is at once "activated" and reacts vigorously with the acid until dissolved.[5] The experiment is a striking one and easily performed. In my own demonstrations a piece of pure iron wire (No. 20 piano wire, bent at one end into a hook for handling) is passivated by immersion in strong nitric acid (s. g. 1.42) for a few seconds, and is then placed (by means of a glass hook) in a flat dish containing dilute acid (s. g. 1.20). The wire if left undisturbed remains bright and unaltered for an indefinite time. If then it is touched at one end with a piece of ordinary iron, or with zinc or another baser metal, the bright metallic surface is at once darkened (through formation of oxide) and active effervescence begins; this change is transmitted rapidly, though not instantaneously, over the entire length of the wire; the velocity of transmission varies with the conditions, and is of the order of 100 or more centimeters per second in this experiment. The wave of activation may also be initiated *mechanically*, *e. g.*, by bending the wire or tapping it sharply with a glass rod; or *chemically*, *e. g.*, by contact with a reducing susbtance such as sugar; or *electrically*, *e. g.*, by making the wire (while immersed in the acid) the cathode in any battery circuit (of two or more volts potential), preferably with another piece of passive iron wire as anode;

[4] *Cf. Amer. Jour. Physiol.*, 1914, Vol. 34, p. 414; Vol. 37, p. 348.

[5] For a recent extended study of the passive state in metals with full references to the literature, *cf.* Bennett and Burnham, *Jour. Physical Chem.*, 1917, Vol. 21, p. 107.

the cathodal wire is instantly activated, while the anodal wire remains unchanged. Activation with the electric current is thus typically a polar phenomenon, just as is the excitation of a living irritable element like a nerve.

Activation by contact with active iron or a baser metal is in reality an instance of electrical activation, the activating metal forming the anode of the local circuit arising at the region of contact. At the local cathode, *i. e.*, the adjoining passive iron, the metal is at once activated, and the effect spreads in the manner already indicated by means of the circuit which automatically arises at the boundary between active and passive areas. Any metal which thus activates by contact must be of such a nature that the passive iron becomes the *cathode* of the local circuit formed. A metal which is nobler than passive iron, like platinum, not only does not cause activation, but it renders the iron locally more resistant to activation; thus the passage of the activation wave may be blocked by the contact of a platinum wire. This latter effect depends upon the formation of a local circuit of the reverse orientation, the iron becoming anodal, a condition which furthers passivation and hinders activation. Active iron is a base metal in relation to passive iron, being more negative that the latter by *ca.* 0.75 volt in 1.20 HNO_3; hence when any region of a passive wire is rendered active it immediately activates the adjoining areas.

In passivation the surface layer of the iron is modified in a peculiar manner, apparently by the formation of a thin resistant layer of higher oxide. Any condition that interrupts locally this surface film of altered iron forms necessarily a local circuit by whose action the whole metal is activated in the manner just described. Apparently at any cathodal area the surface film of oxide is reduced to metallic iron; contact of a reducing substance has a similar effect; while a mechanical agent breaks the continuity of the film and exposes the unaltered iron beneath, thus forming the local circuit. The reason why mechanical, chemical and electrical influences all produce the same effect is thus evident. The parallel to the living irritable tissue is plain; local alteration of the protoplasmic surface film produces effects of a closely comparable nature, which spread in an analogous manner by means of the local electrical circuits formed. We are thus enabled to understand why any rapid local alteration of the cell surface may activate the whole cell—in other words why the cell is so characteristically "irritable." The iron wire in its passive state may be compared to the irritable living element in a state of rest. The state of inactivity continues in both cases only so long as the surface layer is intact and homogeneous. The reason why the *whole* cell (or the whole iron wire) responds completely to a local stimulus is simply because transmission over the entire surface follows automatically and inevitably upon local activation. The "all-or-none" behavior thus becomes intelligible.

Under normal conditions an irritable nerve or muscle returns spontaneously to an inactive or "resting" state after stimulation, and for renewal of activity a second stimulus is required. The resting condition thus represents a condition of equilibrium, which is temporarily disturbed by the stimulating agent. The same is true of the passive condition of iron in *strong* solutions of nitric acid. In weaker solutions, of s. g. 1.20 and less, the reaction once initiated continues unchecked until all of the iron is dissolved; but in stronger solutions *the reaction is temporary and the metal returns spontaneously to the passive condition.* A wave of temporary activity thus sweeps over the surface of a passive iron wire which is activated (*e. g.*, by touching with zinc) in nitric acid of s. g. 1.25 or higher; the state of local activity lasts in such a solution for a brief period only, which is the shorter the higher the concentration of the acid. An interesting gradation of effect may thus be shown by activating a series of passive wires in different dilutions of strong (s. g. 1.42) acid, *e. g.*, 90, 80, 70, 60 and 55 volumes per cent. (*i. e.*, 90 c.c. 1.42 HNO_3 *plus* 10 c.c. water, etc.). When a wire immersed in pure 1.42 acid is touched at one end

with a piece of zinc a momentary flash-like wave of activation is seem to pass rapidly along the whole wire; the local reaction lasts for only a small fraction of a second and is instantly reversed; a slight temporary darkening of the metallic surface and a trace of brown coloration (due to reduction of the acid to lower nitrogen oxides) are the only visible effects; in 90 per cent. acid a similar though somewhat more prolonged reaction takes place; in 80 per cent. acid there is slight visible effervescence for a fraction of a second; in 70 per cent. the effervescence lasts for about one second and the darkening of the metallic surface is more pronounced; while in 60 per cent. the reaction occupies two or three seconds and in 55 per cent. five seconds or more, and a considerable accumulation of brown oxide is formed at the surface of the metal. It would thus appear that in the stronger solutions the oxidation which forms the protective surface film takes place so rapidly that only a momentary reaction of the metal with the acid is possible; as the concentration of acid decreases the surface film forms more slowly and the reaction lasts longer, until at a certain critical concentration (about 50 per cent.; *ca.* 1.20 s. g.) the surface oxidation becomes so gradual that its passivating influence is insufficient to interfere with the continued solution of the metal in the acid.

Two chemical reactions of opposite character thus take place successively as the activation wave passes any region of the metallic surface; first, the local cathodic reduction which removes the protecting layer of oxide and enables the metal to react with the acid; and second, the immediately succeeding oxidative process which reforms the protective surface film and arrests the reaction. A factor of importance in this process of repassivation is apparently the electrochemical oxidative action at the local anode. As the activation wave advances, the surface film is disintegrated at the cathodal region immediately in advance of the wave front; this region then instantly becomes active, *i. e.*, anodal; in other words, it undergoes a change of condition which in itself tends to check or arrest the reaction. This is because of the characteristic passivating influence at the anode; the reaction of a piece of active iron wire in 1.20 HNO_3 may in fact be brought to rest and the wire rendered passive by passing a strong current through it as anode for a few seconds.[6] As the activation wave passes, each region of the metallic surface thus becomes alternately cathodal and anodal. Making the passive metal cathode has an activating effect, while making the active metal anode tends to passivate. This latter electrochemical action is added to the direct passivating action of the acid. Hence in acid of a sufficient strength the local reaction is automatically self-limiting as well as self-propagating. This peculiarity depends directly upon the properties of the surface film, which when the metal is cathode undergoes dissolution, and when the metal is anode is reformed. Apparently in strong acid the metal is in a condition where a slight local increase of reducing influence initiates the activating reaction and a slight increase of oxidizing influence inhibits it. We have here another parallel to the condition in an irritable element like a nerve fiber, where cathodal polarization promotes and anodal polarization inhibits the local reaction (electrotonus). In both cases the alternate disintegration and reformation of a surface film under electrochemical influence appear to be the essential features of the local process.

The passage of the wave of activation can be observed with especial clearness in a passive iron wire which has been dipped in a test-tube containing 1.42 HNO_3 and is then suspended vertically in air and touched at its lower end with zinc. The adhering layer of acid is so thin as to increase greatly the resistance of the local circuit between active and inactive regions, and the local reaction spreads with corresponding slowness, at a rate of only a few (5 to 10) centimeters a second. As the

[6] Contact of a piece of platinum foil with a reacting iron wire has the same effect; near the platinum the iron soon ceases reaction and becomes passive, and the effect then spreads over the whole wire. This phenomena is biologically interesting, as a case of transmission of inhibitory influence.

reacting region extends upward the bright surface of the iron is darkened locally for a distance of two or three centimeters; behind this advancing active region the wire again becomes bright and inactive. The visible effect is that of a slight temporary darkening or clouding which travels upward along the wire. After the wave has passed over the whole length of the wire the latter, when tested by dipping in 1.20 acid, is found to be again passive; the temporary and reversible character of the activation is thus shown. A similar slow spreading of the active state takes place in a passive wire dipped in weaker (1.20) acid and then activated as above, but in this case there is no spontaneous return to passivity; the whole wire remains dark, and when again placed in 1.20 acid at once reacts vigorously in the usual manner of active iron. Spontaneous reversal thus takes place only in the strong acid.

In the experiment just cited the rate of transmission is lowered by increasing the electrical resistance of the local circuit, but in other respects there is no essential difference from the conditions observed in immersed wires. A noteworthy feature of these phenomena is that after a wire has been activated while immersed in strong acid (*e. g.*, 80 per cent. 1.42) some time elapses before a complete reaction can be again excited; *i. e.*, a period of insensitivity and imperfect transmission always follows the spontaneous return of passivity. Contact with zinc within the first four or five minutes after activation causes typically only a local reaction which may be transmitted slowly for a few centimeters but then dies out; some minutes later transmission takes place more rapidly and through a longer distance; but it is usually only after ten or fifteen minutes (the exact time varying with the conditions) that perfect transmission through an indefinite distance becomes again possible. The recovery of the original condition thus requires some time, the exact interval varying with the concentration of acid, and in general decreasing with decreasing concentration. This phenomenon also has its biological analogies, and may be compared to fatigue, or possibly to the refractory period which typically follows stimulation in all irritable tissues. Evidently the reformed surface film regains its former sensitive properties by a progressive and somewhat gradual process.

This tendency to an automatic restoration of the protective surface layer of oxide after local removal is probably the essential condition underlying another characteristic feature of the electrical activation of passive iron, namely, that a slowly increasing current passed through the wire (as cathode) is much less effective in causing activation than a current of similar strength which attains its full intensity rapidly or instantaneously. In this respect also the passive metal resembles the living irritable tissue. If the current leading to the two passive wires immersed in 1.20 HNO_3 is derived by means of a stationary and a movable zinc electrode from a bath of zinc sulphate solution forming part of a circuit of several storage cells—an arrangement enabling the potential of the "shunt current" to the iron wires to be varied at will—it is found that a gradual increase of the current, from near zero to an intensity which in itself is amply sufficient to activate with sudden closure, is typically without effect. Evidently a *sudden* change of surface polarization is needed; if the change is gradual it seems that the oxidative action of the acid in contact with the metal has time to reform the passivating protective layer as fast as it is reduced by the cathodal action.

The chief of the foregoing resemblances between the passive iron wire and the irritable living element may now be briefly summarized as follows: (1) Mechanical, electrical and chemical agencies have the same activating effect; (2) electrical activation is a polar phenomenon (analogy to the law of polar stimulation); (3) the local state of activity is propagated along the wire at a velocity which is similar in its order to that of the excitation wave in living tissues; (4) whenever activation is excited by any means in a passive wire immersed in a definite solution of acid (*e. g.*, 70 per cent. 1.42 HNO_3) the *whole* wire is

involved and the reaction lasts for a definite time; *i. e.*, the character, intensity and duration of the reaction are independent of the nature of the activating agent; the metal either reacts completely or not at all (analogy to the "all-or-nothing" behavior of irritable living elements); (5) a wire which is polarised anodically while immersed in acid is activated with difficulty and the activation wave tends to travel for only a short distance (analogy to anelectrotonus in nerve); (6) the spontaneous return of passivity in strong acid is immediately succeeded by a period during which the metal is less responsive than before (analogy to fatigue effect or refractory period); (7) a current which reaches its full intensity gradually is less effective than one which reaches the same intensity suddenly; and finally (8) the local chemical surface reaction of activation is constantly associated with a variation of electrical potential, the active region becoming negative relatively to the inactive regions (analogy to the bioelectric variation or "action current" of an active living tissue).

The chief characteristics of this electrical variation are readily demonstrated as follows. When two iron wires connected with the binding-posts of a voltmeter of suitable scale are passivated and placed side by side in a vessel containing 1.20 HNO_3, no potential difference is shown. If then one wire is activated the instrument at once indicates a P.D. of 0.7 to 0.8 volt, with the active wire negative; this P.D. remains constant while the reaction continues in the one wire; if then the other wire is also activated the P.D. again falls to zero. The active wire is thus anodal, the passive wire acting like a noble metal. If the same experiment is performed with stronger acid (55 per cent. 1.42 or higher) a similar but *temporary* excursion of the needle is seen, lasting for the period of the reaction. In acid of 55 or 60 per cent. the potential exhibits irregular rhythmical fluctuations for the few seconds during which the reaction continues, and the needle swings by degrees back to zero and somewhat beyond as the reaction subsides and ceases. Immediately after the return of the passive condition the activated wire is always found slightly more positive than before, usually by *ca.* 0.02 volt; after an interval of some minutes—corresponding apparently in its duration to the insensitive or refractory period above described—the original potential returns. The wire may then be again reactivated and the same process is repeated. This tendency to overpass the original potential after the return of passivity recalls the similar phenomenon in nerve known as the "positive after-variation," and suggests a similarity in the general conditions under which the surface film is reconstituted in the two cases.

The variation of potential associated with the transmission of the activation wave may be demonstrated in a single wire which is connected near its opposite ends with a sensitive string galvanometer (by means of thin passive iron wires) and immersed in 70 or 80 per cent. acid. If the wire is activated at one end the string shows a quick excursion, first in the one direction, then in the other, the deflection showing that at each leading-off region the wire becomes first negative and then positive. The curve of movement is thus comparable to the typical "diphasic" action current curve of a nerve conducting an impulse.

The amplitude of these variations of potential in metals is of course much greater than that found in living tissues, but in their general characteristics both classes of phenomena give unmistakable evidence of being conditioned in the same manner. In the case of the metal it is certain that the effect depends upon a sudden alteration of the electromotor properties of the surface layer. In living tissues and cells there is also much evidence that a change in the protoplasmic surface layer (or so-called plasma-membrane) involving increased permeability and altered metabolism is constantly associated with stimulation, and that the variation of electrical potential is due primarily to this change. Thus in both living system and metal the electrical variations are the expression or indication of changing chemical and structural conditions in the surface layer. The local interruption

or removal of the surface film of oxide in the metal is comparable with the increase of permeability in the living element.

A significant general analogy to physiological conditions is also to be seen in the readiness with which the active state is transmitted from an active to a passive metal by *contact*. Transmission of excitation from one cell or cell element to another by contact is frequent in organisms; and many characteristic structural arrangements, especially in the nervous system, give evidence that such transmission is a normal and constant physiological process; the interlacing of dendrites from different neurones, contact of nerve cells with one another by "end-feet" and similar structures, the histological characters of the myoneural junctions and other nerve endings—which typically form contact with the *surface* of the cell—may serve as examples. Instances of transmission by contact in metals have been given above. A good demonstration is the following: if a number of passive iron wires are placed in contact with one another in a dish of nitric acid, and any single wire is touched with zinc, *all* immediately become active. A long fine passive wire in contact at one end with a large piece of passive iron, *e. g.*, a nail, will on activation at its other end rapidly conduct and transmit the state of activation to the terminal object. Another remarkable feature of this phenomenon is that the transmission between different metals may be *irreciprocal;* this may be shown by using wires of the two metals, iron and nickel, which differ in the readiness and rate with which activation takes place. A momentary contact with active nickel will instantly activate a piece of iron wire in 1.20 HNO_3, but under the same conditions a piece of passive nickel is activated slowly and only after prolonged contact. Consequently, while briefly touching passive iron with active nickel immediately and completely activates the iron, touching passive nickel with active iron is typically ineffective or has only slight local effect. In other words, transmission of activation takes place rapidly and readily from nickel to iron, but not in the reverse direction. The difference depends upon the relative slowness of the activation process in nickel; in this metal the local reaction tends to start slowly and to reach its maximum slowly, and the rate of transmission is correspondingly gradual. Such facts suggest the possibility that the characteristic irreciprocality of transmission in reflex arcs may depend upon similar differences in the time factors of excitation of the interacting neurones at the synapses. The recent work of Lapicque and Keith Lucas has shown clearly the fundamental importance of the time factor in the excitation process.[7]

It seems clear that variations in the electromotor properties of the surfaces concerned—respectively the metallic surface and the cell surface—form the essential feature of activity which is common to both types of system and upon which the above various similarities of behavior depend. These variations are due to changes in the physical and chemical character of the surface layer, which in both cases is water-insoluble, chemically unstable, and in contact with an electrolyte solution. Experiment shows that in the passive metal this surface film is in a characteristic state of equilibrium which is readily disturbed, and the same appears to be true of the protoplasmic surface film in an irritable cell or cell element.

This general similarity probably explains another peculiarity of behavior common to both systems, namely a tendency to automatic rhythmical fluctuations of potential and chemical action; this phenomenon is seen in the solution of many metals in nitric acid, and also in the well-known rhythmical catalytic decomposition of hydrogen peroxide in contact with mercury. Alternation of activity and passivity, due to rhythmical formation and dissolution of a surface film of oxide or other protective material, appears to underlie these phenomena in metals. In living organisms rhythmical action is also highly characteristic, and is presumably due to analogous conditions.

The general view that the semi-permeable

[7] Similarly with transmission from element to element. Lapicque's work indicates that the failure of transmission from nerve to muscle in curare poisoning is due to "heterochronism."

cell surfaces may have electromotor properties similar in certain respects to those of metallic surfaces has long been familiar to physiologists; and the so-called "membrane theory" (or theories) of the bioelectric potentials, which originated in a suggestion of Ostwald in 1890 and has been developed in considerable detail by Bernstein, Höber and others, has referred the physiological variations of potential to variations of permeability or to other changes in the plasma-membrane. It seems best, however, to avoid for the present too special conceptions of the precise nature of the processes concerned in these phenomena and to regard the latter from a broader and more generalized point of view. Variations of phase-boundary potentials, with associated or dependent chemical effects, appear to constitute the general type of phenomenon involved. More recently the work of Haber, Beutner and especially of Loeb and Beutner in collaboration, has demonstrated many fundamental resemblances between such potentials and the bioelectric potentials, and is of the highest interest in relation to this general problem. The work of Loeb and Beutner, together with that of Macdonald, indicates that organic membranes and cell-surfaces behave as if reversible (in the electrochemical sense) to cations as a class; in this respect they resemble the surfaces of solutions of lipoids in organic solvents; and it seems probable that the demarcation-current potentials are thus to be explained. I am inclined, however, in view of the conditions in passive iron as well as for more purely biological reasons, to regard the local bioelectric circuits accompanying normal cell activity as representing primarily some type of oxidation reduction element. In general the physiological effects observed at the respective regions where the electric current enters and leaves the cell-surface are *opposite* in character, and the same must be true of the underlying chemical or metabolic processes. Oxidation at one area, simultaneously with reduction at another area—these chemical changes involving synthesis as well as decomposition—seems to be a more probable source of the normal currents of action, especially when the dependence of vital phenomena on oxidation and synthesis and the interdependence of the two latter processes are considered. Further discussion of the possible relations between the bioelectric processes and cell-metabolism, with a fuller account of the facts described in this article, must be reserved for a more complete paper.

RALPH S. LILLIE

CLARK UNIVERSITY

THE INTER-ALLIED SCIENTIFIC FOOD COMMISSION[1]

THE Inter-Allied Scientific Food Commission now sitting in London has already at previous meetings accomplished a good deal of work, and if its recommendations are carried out, the provisioning of allied countries will be placed on a sound scientific basis. That its recommendations will be carried out seems to be more or less guaranteed by the fact that it was established as a result of a decision of the Inter-Allied Conference held in Paris last November. The Conference directed that the inter-allied scientific commission should consist of representatives of France (Professors Gley and Langlois), Italy (Professors Botazzi and Pagliani), United States (Professors Chittenden and Lusk), and the United Kingdom (Professors E. H. Starling and T. B. Wood). It was instructed to meet periodically in order to consider from a scientific point of view the food problems of the Allies and in agreement with the inter-allied executives to make proposals to the allied Governments. The commission held its first meeting in Paris on March 25, and its second in Rome on April 29. Before its present meeting in London a representative of Belgium, Professor Hulot, was added. A memorandum upon the work of the commission, furnished to us by the food controller, contains some particulars enlarging the information published in previous issues.

At its first meeting last March in Paris the commission came to an agreement as to the minimum food requirements of the average man. It was laid down that for a man weigh-

[1] From the *British Medical Journal*.

ing 70 kilos, or 154 lb., doing average work during eight hours a day the food as purchased should have an energy value of 3,300 calories a day, but that a reduction of 10 per cent. could be supported for some time without injury to health. The commission accepted the figures of Professor Lusk, one of the representatives of the United States, for the proportion to be assigned to women and to children of different ages. At the second meeting, in Rome, the metric ton (a metric ton is 0.9842 ton British) was adopted as the unit for estimating the weights of the various foods produced in each allied country. A "man value"—that is to say, the number of average men equivalent to the population of each of the allied countries—was established, and was taken as a basis for calculating the amount of food to be provided for the adequate nourishment of the total population of each country. An estimate was then formed of the home production of the soil furnished by each allied country in 1918–19 to serve as a basis for determining the amount of food available for men and animals, respectively, in each country.

It was not thought desirable to fix a minimum meat ration, in view of the fact that no absolute physiological need exists for meat, since the proteins of meat can be replaced by other proteins of animal origin, such as those contained in milk, cheese and eggs, as well as by proteins of vegetable origin. It was, however, considered desirable to fix a minimum ration of fat; this it was decided should be 75 grams—about 2⅝ oz. per average man a day. It is to be noted that the fat ration may be made up from fats partly of vegetable origin and partly of animal origin, and the commission expresses the opinion that if the amount of fat of vegetable origin was found to be insufficient it might be necessary to maintain a certain stock of animals to make good the deficit.

The commission has recommended that the maximum possible proportion of all cereals except oats should be reckoned in when calculating the amount of calories available for man. As to milling, it has advised that a uniform extraction of 85 per cent. should be adopted in all the allied countries; this will vary from 80 per cent. in summer to 90 per cent. in winter, and will apply to the United States only as regards their internal consumption, and then only in case of scarcity. While man should always take precedence over animals in the allocation of food by governments, it is recognized that the methods adopted for reserving the maximum possible proportion of the cereals for the use of man may vary in each country. The opinion is therefore expressed that in fixing prices it is the prices of animal products which should be limited rather than those of such vegetable products as may serve equally well for feeding men and animals. The production of veal, pork and poultry at the expense of other food immediately available for man should therefore be discouraged and this may best be done by fixing prices for those animal products which will make it unprofitable for the producer to fed the animals on cereals. The chief subject now under consideration is the examination of statistics which will render it possible to ascertain the calorie value of the home production of each of the allied countries. The comparison of these figures with the needs in calories of the population of each country will enable the commission to deduce the amount of imports necessary for the maintenance of the population, or the exportable surplus, as the case may be.

The commission has also expressed the opinion that any propaganda having for its object the encouragement of food production and of economy in the use of food should be organized and directed by men of science well acquainted with the subject. The members of the commission itself fulfil this condition, to the importance of which we had occasion some time ago to call attention, for this elementary principle was at first neglected in this country. It appears that the truth of this principle is beginning to be recognized in Germany, where voices are being raised in favor of consultation of scientific and medical experts by the authorities.

SCIENTIFIC EVENTS

THE ASPHALT INDUSTRY IN 1917

The war has stimulated activity in the domestic markets for asphaltic material derived from crude petroleum and for imported asphalt, but the relative abundance and adaptability of those materials has lessened the demand for the native bitumens and for the various types of bituminous rock produced in this country, according to statistics just completed under the supervision of J. D. Northrop, of the United States Geological Survey, Department of the Interior.

The native bitumen, including maltha, gilsonite, elaterite and grahamite, bituminous rock and ozokerite, marketed from mines and quarries in the United States in 1917 was 80,904 short tons, a loss of 17,573 tons, or 18 per cent., compared with 1916. The market value of the output in 1917 was $735,924, a loss of $187,357, or 20 per cent., compared with 1916.

The production of gilsonite, bituminous sandstone, bituminous (elaterite) shale, and ozokerite was increased considerably in 1917, but the gain credited to these varieties was insufficient to offset the loss in the production of elaterite, grahamite and bituminous limestone.

The quantity of manufactured asphalt (including road oils and flux) produced in 1917 from petroleum of domestic origin increased about 2 per cent. compared with 1916, and the quantity of corresponding material manufactured in this country from Mexican petroleum increased about 13 per cent., as a consequence of which the net gain over the production in 1916 was nearly 7 per cent.

The total sales in 1917 of manufactured asphalt derived from domestic petroleum amounted to 701,809 short tons, valued at $7,734,691. This total includes 327,142 tons, valued at $4,011,980, of solid and semisolid products used in the paving and roofing industries, and 374,667 tons, valued at $3,722,711, of liquid products, including road oils, flux and asphaltic paints.

California maintained its supremacy in the production of oil asphalt. Its output from 14 petroleum refineries in 1917 aggregated 220,294 tons, valued at $2,100,252, and included 135,160 tons of solid and semisolid products, valued at $1,486,609, and 85,134 tons of liquid products, valued at $613,643. Refiners handling oil from the Oklahoma-Kansas field produced 206,223 tons of oil asphalt, valued at $1,957,493, including 73,410 tons of solid and semisolid products, valued at $747,651, and 132,813 tons of liquid products, valued at $1,227,842.

The total sales in 1917 of manufactured asphalt derived from Mexican petroleum amounted to 645,613 short tons, valued at $7,441,813, and included 338,485 tons of solid and semisolid products, valued at $4,657,152, and 307,128 tons of liquid products, valued at $2,784,661.

The imports of native asphalt, oil asphalt, and bituminous rock for consumption in the United States in 1916 aggregated 187,886 short tons, valued at $993,115, a gain in quantity of 40,173 tons, or 28 per cent., over 1916. The exports of unmanufactured asphalt in 1917 amounted to 30,107 short tons, valued at $587,256, a loss of 10,709 tons, or 35 per cent., compared with 1916. In addition asphalt products to the value of $585,472, compared with $494,895 in 1916, were exported in 1917.

TRAINING CAMPS FOR INSTRUCTORS TO PREPARE COLLEGE MEN FOR MILITARY SERVICE

The War Department authorizes the following statement from the Adjutant General's office.

Training camps to fit men to act as assistant instructors in the new Students' Training Corps will be held at Plattsburg, N. Y., Fort Sheridan and Presidio, Calif., from July 18 to September 16. Colleges have been invited to send a limited number of picked students and members of the faculties to these camps.

The camps will be conducted with a view to teaching the attendants to give military instruction to students, and it is believed that satisfactory results can be obtained from an intensive 60-day course.

Further instructions relative to the new corps have just been issued. These are being sent to all colleges that have signified their

willingness to establish corps among their students.

The purpose of the new plan, as shown in the new instructions, is to develop as a great military asset the large body of young men in the colleges. This will be accomplished by providing efficient military instruction under the supervision of the War Department for students in all colleges enrolling the required minimum of students. In order to receive this instruction, all students over eighteen years of age must volunteer and enlist in the army of the United States.

Only colleges which can provide an enrollment of 100 or more able-bodied students over eighteen years will be entitled to the course. The intention is to extend the system of instruction for college students to the largest practicable extent in view of the available supply of officers and equipment. To be classified as one of the institutions of college grade to which the privilege of maintaining a Students' Army Training Corps unit is extended, an institution must require for admission to its regular curricula graduation from a standard secondary school or an equivalent; must provide general collegiate or professional curricula covering at least two years of not less than 33 weeks each; and must be carried in the lists of higher institutions prepared by the United States Commissioner of Education.

Institutions of college grade will include, providing all other conditions are met: Colleges of arts and sciences; engineering schools; schools of mines; agricultural colleges; colleges of pharmacy, veterinary, medicine; teachers' colleges, and law, medical, dental, graduate and normal schools; junior colleges and technical institutions. Students enrolled in preparatory departments of these schools and colleges can not at present be considered eligible for enlistment in the units, and such students can not be counted by college authorities in reckoning the 100 able-bodied students for a military training unit.

The character of the training will depend on the kind of training unit which is organized in the particular institution. The standard time to be allotted to military work will be 10 hours per week during the college year supplemented by six weeks of intensive training in a summer camp. The 10 hours a week will not involve the hours of outdoor work in drill.

The summer camps will be an important feature of the system. These will be active for six weeks, and there will be an intensive and rigid course of instruction under experienced officers.

The plan will provide approximately 650 hours of military work per annum. It is expected that this will qualify a considerable percentage of the students to enter officers' training camps on being called to the colors, and a large percentage of the remainder to serve as noncommissioned officers.

Officer instructors and noncommissioned officer instructors will be provided by the War Department when available. Officers returning from overseas and unfit for further field service will be utilized. The government will supply the uniforms and equipment whenever available.

The Students' Army Training Corps will be supervised and controlled by the training and instruction branch, war plans division of the General Staff, in accordance with the instructions of the Chief of Staff. An advisory board to this committee, representing educational interests, has already been appointed by the Secretary of War. This will insure the closest cooperation between the War Department and the colleges.

GUARDING SOLDIERS' CAMPS AGAINST FLIES AND MOSQUITOES

THE following statement is authorized by the War Department from the Surgeon General's office:

To guard troops stationed in camps and cantonments from disease carried by mosquitoes and flies, the medical department of the Army has installed a system of prevention which is safeguarding not only the soldiers but also civilians living in the neighborhood of training camps.

There is attached to each camp a division surgeon who is responsible for the health of the camp. Assisting him is a sanitary inspector who has the assistance of a sanitary

engineer and from 100 to 200 enlisted men who are continually employed in work designed to protect the health of the soldiers.

Special attention is now being given in all camps to cleaning up spots where mosquitoes and flies breed. In some cases it has been necessary to dig channels in streams, drain swamps, and put in elaborate ditching systems in order to clean up stagnant pools and streams. In those cases where it has been found impossible or impracticable to drain swamps and to do other work of a similar nature, there has been installed a system for keeping these slow-moving streams and still bodies of water covered with oil. At all points within the camp where there is the slightest possibility of mosquitoes or flies breeding daily spraying of oil is done.

Arrangements have been completed wth the Federal Public Health Service to carry out a similar program in the territories adjacent to the camps. The Health Service has agreed to fill bogs, open streams and drain swamps and continue the oil spraying for a distance of 1 mile around all camps.

Special precautions have been taken to prevent the spread of disease by flies. With the approach of the fly season a general order was sent to all division surgeons and other health officers to take all necessary steps to prevent the breeding of flies. Instructions were given on the disposal of materials that were likely to become breeding spots. Arrangements were made to protect all food from flies. With this end in view all buildings in which food is prepared or stored were screened. The entrance to the buildings have been vestibuled. An added guard is the placing of flytraps in all buildings. An average of 6,000 such traps have been placed in each camp. More than 22,700,000 square feet of screening has been placed in all camps.

THE WEATHER BUREAU AND DR. CLEVELAND ABBE

The Secretary of Agriculture has removed Dr. Cleveland Abbe, Jr., from his position in the Weather Bureau by the following order:

> For the good of the service you are hereby removed from your position as meteorologist in the Weather Bureau of this department, effective at the termination of July 3, 1918.

In transmitting Mr. Houston's order Dr. C. F. Marvin, chief of the Weather Bureau wrote:

> I find myself confronted with the most painful duty of transmitting to you the inclosed letter, received this morning from the department, removing you from the government service. The reasons for this action are connected altogether with your conduct and your long-standing and generally well-known friendly sympathies for the imperial German government.
>
> The bureau is not in possession of any of the details of investigation or records leading to this action by the secretary, but it is known to result from investigations made by the Department of Justice, and which I may say were not the result of any suggestions or representations by employees of the Weather Bureau, but were initiated entirely by outside sources.
>
> A searching inquiry of your innermost heart in respect to your attitude toward the United States government must convince you that patriotism and genuine loyalty to the United States are absolutely incompatible with friendly sentiment for Germanism.

Denial of these charges is made in a letter written to Dr. Marvin by Dr. Abbe on July 7. The letter follows:

> Your communication of the third, transmitting the very brief but astounding and inexplicable letter of the Secretary of Agriculture, so overwhelmed me with new duties and emotions that I have but now come to the realization of the unjust and even insulting accusations it contains to the effect that I have "friendly sympathies for the imperial German government" and "friendly sentiments for Germanism." These I must indignantly deny.
>
> We have spoken together on this subject and you know that I have always distinguished between the German people and the actions of the imperial government since 1914, and I am glad to see that your letter indicates that you do not believe the truth of the statements you make concerning me. If you did believe them, duty would have required you to report me to the Department of Justice; but you state explicitly that the present action is "not the result of any suggestions or representations by the employees of the Weather Bureau." However, since you have placed such a statement

concerning me in the Weather Bureau files on this matter, I must ask to register herewith, in the same files, my indignant denial of any friendly feeling toward or sympathy for the imperial German government and my abhorrence of its official acts. I also repudiate indignantly the suggestion that I have, or could have, anything in common with what is now currently known as "Germanism."

It should not be necessary, but I once again do protest my sincere, genuine and undivided loyalty to the United States and to its government, its ideals, and particularly its published objects in this war. The most searching inquiry of my own acts and feelings fails to reveal to me any deficiency in this respect. It is well known to you that I have subscribed to the extent of my ability to the second and third liberty loans, to the Red Cross and its work, and to other activities.

You are, yourself, convinced of the truth of my statements, and, as you do not wish to see an unjust disgrace laid upon the name I bear, I believe you will aid my efforts to secure the common justice of an opportunity to learn from the Secretary of Agriculture the charges collected against me and to answer them fully in his presence.

GROVE KARL GILBERT

IN the *Journal of Geology* Professor Thomas C. Chamberlin pays the following editorial tribute to the late Dr. Gilbert:

The passing of Dr. Gilbert after almost seventy-five years of activity deprives geological science of one of its ablest and most honored representatives. It is permitted to few men to leave an equally enviable record. To an unusual degree his work was distinguished by keenness of observation, by depth of penetration, by soundness in induction, and by clarity of exposition. It is doubtful whether the products of any other geologist of our day will escape revision at the hands of future research to a degree equal to the writings of Grove Karl Gilbert. And yet this is not assignable to limitation of field, or to simplicity of phenomena, or to restriction in treatment. The range of his inquiries was wide, his special subjects often embraced intricate phenomena, while his method was acutely analytical and his treatment tended always to bring into declared form the basal principles that underlay the phenomena in hand.

In the literature of our science the laccolith will doubtless always be associated with the name of Gilbert. In its distinctness as a type, in its uniqueness of character, and in the definite place it was given at once by common consent, one may almost fancy a figurative resemblance between the laccolith and its discoverer and expositor. Gilbert's monographs on the Henry Mountains and on Lake Bonneville will long stand as unexcelled models of monographic treatment. His contributions to physiographic evolution, particularly his analysis of the processes that end in base-leveling, link his name with that of Powell, and give to these two close friends a unique place as joint leaders in interpreting morphologic processes. Glacial and hydraulic phenomena were also fields in which Gilbert's powers as an investigator and expositor were signally displayed.

In accuracy of delineation, in clearness of statement, and in grace of diction Gilbert's contributions are certain long to stand as models of the first order. His personality was of the noblest type; he was a charming companion in the field; he was a trusted counselor in the study. The high place he has held in the esteem of coworkers is quite certain to merge into an even higher permanent place to be accorded him by the mature judgment of the future.

SCIENTIFIC NOTES AND NEWS

THE annual convocation meeting of the American Federation of Biological Societies will be held this year in Baltimore. The date of the meeting is from December 30 to January 1 inclusive. The federation includes the following national societies: The American Physiological Society, the American Society of Biological Chemists, The American Society for Pharmacology and Experimental Therapeutics, and the American Society for Experimental Pathology.

DR. J. M. T. FINNEY and Dr. William S. Thayer, chief consultants of the Medical Service of the American Expeditionary Forces, have received promotions advancing their rank from major to colonel. The following named officers have been promoted from major to lieutenant-colonel: Thomas R. Boggs, James T. Case, George W. Crile, Harvey Cushing, Joel W. Goldthwait, James F. McKernon, Charles H. Peck, Thomas A. Salmon, Hugh H. Young, N. Allison and E. L. Keyes.

CAPTAIN JOSEPH LEIDY, who has been instructor in gas defense and divisional gas officer of the 30th Division, Camp Sevier,

S. C., has been assigned to the Brady Laboratory, Yale University Medical School, New Haven, Conn., in connection with the Gas Defense Service of the Medical Officers' Training School.

Dr. Treat B. Johnson, professor of organic chemistry in the Sheffield Scientific School of Yale University, is cooperating in research with the chemical section of the War Department, and is acting as director of a field laboratory which has been established in Yale University for gas experimentation work. Associated with him in this work are: Dr. Arthur J. Hill, Dr. Blair Saxton and Dr. Sidney E. Hadley, of the Department of Chemistry, Yale University. Dr. Norman A. Shepard, of the department of chemistry, at Yale University, is working in conjunction with Professor Johnson during the summer months, and is carrying on experimental work dealing with the manufacture of explosives for the government.

At the request of the President, the Secretary of Agriculture has designated as members of the National Research Council Henry S. Graves, forester and chief of Forest Service; Karl F. Kellerman, associate chief, Bureau of Plant Industry, and Raphael Zon, chief Forest Investigations.

Dr. Raymond F. Bacon, of the Mellon Institute of Pittsburgh, now lieutenant-colonel, chief of the Technical Division on General Pershing's staff in France, while on a short visit to this country, was given an honorary doctor of science degree by the University of Pittsburgh.

At the recent commencement of Yale University, Professor Emeritus Theodore S. Woolsey, of the Law School, in introducing Professor E. S. Morse for the honorary degree spoke as follows:

Edward Sylvester Morse—Born in Portland eighty years ago, a student with Agassiz, in the chair of zoology at Bowdoin, the pursuit of Brachiopods led Professor Morse to Japan. Three years in the Orient changed the current of his life. As collector, man of taste and man of letters, he has interpreted Japanese ceramics and Japanese character with loving fidelity. As head of the Peabody Museum in Salem since 1881, he has built up a wonderful institution. As zoologist and ethnologist he has won an enviable name. A double life is his, the happy union of science and of art.

The Angrand Foundation of France has awarded a prize of five thousand francs to Dr. Herbert J. Spinden, assistant curator in anthropology at the American Museum, in recognition of his memoir on *Maya Art*, published by the Peabody Museum of Harvard University. This prize is awarded once in five years for original investigations in the anthropology of North and South America. Dr. Spinden is engaged at present on reconnaissance work in South America.

Dr. Henry Fairfield Osborn, president of the American Museum of Natural History, has been elected an honorary member of the Royal Irish Academy.

Dr. E. R. Weidlein, of the Mellon Institute, has been appointed by President Nichols to represent the American Chemical Society on the Committee on the Supervision of Chemical Engineering Catalogue and as a member of the Perkin Medal Committee and the Committee on Cooperation between Industries and Universities in place of Colonel R. F. Bacon, who is now in foreign military service.

Charles T. Kirk has resigned the positions of professor of geology in the university and the state geologist of New Mexico, to begin consulting practise in geology with offices in Tulsa and Oklahoma City, Oklahoma.

At a recent meeting of the Columbus Section of the American Chemical Society, Dr. W. D. Bancroft made addresses on "Gas warfare," and on "Contact catalysis."

A portrait bust of the late F. Massei, professor of otorhinolaryngology at the University of Naples, was recently installed in the hospital where most of his work has been done.

The Rev. George M. Searle, superior general of the Paulist Fathers from 1904 to 1909, and previously professor of mathematics and director of the astronomical observatory of

the Catholic University, died on July 8, at the age of seventy-nine years. Dr. Searle graduated from Harvard College in 1857 and held positions in the Dudley, Naval and Harvard observatories.

PROFESSOR STEPHEN FARNHAM PECKHAM, known for his work on the chemistry of bitumens, died on July 11, in his eightieth year. Professor Peckham was a graduate of Brown University in the class of 1861, and was professor of chemistry in the University of Minnesota from 1873 to 1880. Subsequently, he was engaged in the work of the U. S. Census, and was in the department of finance of New York City until his retirement in 1911.

LIEUTENANT VERNON KING, formerly scientific assistant in cereal and forage-crop insect investigations, Bureau of Entomology, United States Department of Agriculture, has died from wounds received when the British airplane in which he was serving as a flying observer was shot down. Lieutenant King was attached to the staff of the Wellington, Kans., field laboratory and was in charge of the Charleston, Mo., station prior to November 5, 1914, when he resigned to enter the British army.

EDUCATIONAL NOTES AND NEWS

MOUNT UNION COLLEGE, Alliance, Ohio, has received $512,000 for endowment and equipment to increase its educational work. Successful completion of this fund was made possible by the gift of $50,000 by the friends of the late Captain Milton J. Lichty, M.D., of Cleveland. The professorship of biology will be named in his memory.

THE *Journal* of the American Medical Association states that the national government has modified the statutes of the University of Cordoba in accord with the general demand on the part of professors, students and graduates, giving them a more democratic control. The Academia will retain only its scientific functions, while the direction of the different departments of the university will be in the hands of a managing board for each. The members of these *consejos* are to be elected for a term of three years at a general assembly of all the professors.

BECAUSE of almost continuous absence of Dr. Richard P. Strong since the outbreak of the war, the department of tropical medicine of the Harvard Medical School, has been placed in charge of Dr. Andrew W. Sellards, whose title as associate is now made that of assistant professor.

PROFESSOR C. A. SISAM, of the University of Illinois, has accepted the headship of the department of mathematics in Colorado College. He has been connected with the University of Illinois since 1906.

DR. GEORGE R. BANCROFT has resigned the professorship of chemistry and physics in Transylvania College, Lexington, Ky., to accept a position at the University of Kentucky as assistant professor of organic and physical chemistry.

DR. CHARLES T. BRUES has been promoted to be assistant professor of economic entomology in Harvard University.

DISCUSSION AND CORRESPONDENCE

A MUSICAL, CRICKET-LIKE CHIRPING OF A GRASSHOPPER

IN August, 1917, I made frequent trips to a certain swamp near Spring Hill, Vinson Station, Va., to study the stridulating habits of a colony of locusts, *Neoconocephalus Exiliscanorus* (Davis), which have been located here for several years. The usual notes of the cone-headed grasshoppers (*Neoconocephalus*), are quite devoid of any musical tone such as is characteristic of the chirpings and trillings of the crickets. In truth, the sounds produced by these insects are usually harsh, lisping or rasping noises which may be intermittent or prolonged, depending upon the species. The stridulations of the cone-headed grasshopper (*N. Exiliscanorus*) are of the intermittent type, and are brief, insistent phrases—zeet—zeet—zeet—zeet—zeet, delivered very regularly

for a certain period, followed by a brief pause before the performance is repeated. The notes of the members of the particular colony located near Spring Hill appeared to be rather louder than the notes of some individuals of this species which I have heard elsewhere.

On the evening of August 21, I again visited this colony, the individuals of which were just beginning their usual nocturnal stridulations. While listening to their rather harsh, unmusical phrases, a loud, musical chirping started up, low down in the herbage and underbrush nearby. It was similar to the chirping notes of a cricket, and possessed the true tonal quality characteristic of the notes of such crickets as are found in the genera, *Gryllus, Œcanthus,* or *Orocharis.* I was actually somewhat startled by the loud, unfamiliar chirping, for I could not think of any species of cricket in this locality which I had not determined. After a careful search with a pocket flashlight, I located the musician, which, much to my surprise, proved to be the cone-headed grasshopper (*N. Exiliscanorus*). With the exception of the acquired cricket-like, musical pitch or tonal quality, the notes were delivered in a manner typically characteristic of this cone-headed grasshopper. I captured the insect and compared its tegmina with the tegmina of individuals stridulating in the normal manner, but could determine no particular differences in the stridulating field or the stridulating veins. A microscopic examination of the character of the teeth of the stridulating vein revealed nothing which could be considered responsible for the unusual character of stridulation.

It has always been a mystery to me why the crickets as a class produce stridulations characterized by the musical qualities of pitch and timbre, while the majority of the musical Orthoptera produced only lisping or harsh, strident, unmusical sounds such as are characteristic of the species of *Conocephalus, Orchelimum, Neoconocephalus, Atlanticus, Amblycorypha, Pterophylla,* etc. The question of the origin and evolution of the musical impulse as a dominant feature in the development of the Orthoptera must ever excite the mind to wonder. In this class of insects, sound has become an almost constant and irrepressible feature of their lives. How did the tonal quality become acquired and why is it so constantly associated with the crickets? It is evident that this more musical quality may arise suddenly in the individuals of a species which normally produce only "noise," so to speak, as in the case of the cone-headed grasshopper mentioned. If such a change were associated with the germinal constitution so that it became a transmissible feature and not a merely accidental or temporary individual feature, it would suggest how a musical, cricket-like chirp could arise from a mere rasping note or "noise," and persist as a racial feature. If this were true, the sudden acquirement of the character would be in the nature of a mutation or discontinuous variation, and it is possible that evolutionary steps of this sort have actually occurred in the specialized development of stridulatory powers among the Orthoptera.

H. A. Allard

Washington, D. C.

SCIENTIFIC BOOKS

Field Book of Insects. With Special Reference to those of Northeastern United States. Aiming to Answer Common Questions. By Frank E. Lutz, PhD. G. P. Putnam's Sons. ix + 509 pp. 101 plates.

The text-books dealing with American insects are all excellent but are comprehensive and prepared for the use of students and advanced workers. None of them, however, cover just the field of the present volume. In European countries, where there are many more persons interested in the collection and study of insects than in America, a large number of small well-illustrated volumes are available, where the collector can identify his specimens as well as obtain information regarding their habits. These volumes are of such size that they can be slipped in the pocket and taken into the field for ready reference. There are "Field Books" dealing with American plants and birds, but this is the first one dealing with insects.

Although the "Field Book of Insects" covers a large field, it is convenient in size, 7 x 4½ x 1 inches, weighs about sixteen ounces, and while printed from small type, the printing is well spaced, clear and easily read. There are 101 plates, of which twenty-four are colored. The plates contain 800 figures, which are well drawn and will be of great aid in the identification of specimens. While the majority of the figures are of adult insects, there are many of nymphs, larvæ and pupæ, illustrating the common and peculiar types.

In the choice of the species to be described and figured, the author has evidently made use of his museum experience. The selection is excellent and includes all the common and anomalous species most likely to be met with by the amateur and general collector in the region covered, the northeastern United States. The discussions are interesting and concise. The introduction includes a general discussion on the number of kinds of insects, the scientific names of animals, growth and metamorphosis, anatomy, collecting and breeding of insects, identification and the control of injurious species.

There follows a brief account of the near relatives of insects, but confined in great part to spiders and their webs. The insects are divided into about twenty orders, of which the greater part of the text and a considerable number of the plates are devoted to the Hemiptera, Lepidoptera, Coleoptera, Diptera and Hymenoptera. While it is evidently intended that the figures should be used mainly for the identification of specimens, in the orders named there are analytical tables for the identification of families and genera and, in certain cases, species. The discussion of the Hymenoptera, the last order treated, is followed by a consideration of the abnormal growths or galls produced upon plants by insects. About the only way in which such structures can be identified is by the use of figures and the last seven plates contain figures of the common galls made by mites, Homoptera, Lepidoptera, Diptera and Hymenoptera. In interesting young people, those who tramp and camp, the student of nature, and the farmer who observes the things about him, this book will prove of great value.

ALEX. D. MACGILLIVRAY

NOTES ON METEOROLOGY AND CLIMATOLOGY

RAINFALL OF THE UNITED STATES

MUCH progress has been made in accurate mapping of the rainfall of the United States, and in careful discussion of our now extensive records. In 1917, the Weather Bureau finished the construction of many maps designed to bring out the rainfall features of most importance in agriculture. Possibly by the end of this summer these will be published as a section of the Atlas of American Agriculture. In fact, the map of average annual precipitation has already appeared.[1]

The most important of the unpublished maps are those of the monthly and seasonal rainfalls, and of the frequencies of rains of different intensities. Since the records of several thousand stations have been used, and since the isohyetal lines have been drawn with a careful consideration of topography, these maps show in much greater detail and accuracy than ever before the distribution of the rainfall of the United States.

The distribution has been ably discussed by Professor R. DeC. Ward.[2] The rainfall of the United States east of the Rockies seems to be from moisture originally coming from the Gulf of Mexico and the Atlantic Ocean; and, judging from the distribution of rainfall, the Gulf of Mexico is of primary importance. From the heavily watered north Gulf coast, where the rainfall is 60 inches a year, the amount decreases inland, slowly to the north, but rapidly to the northwest and west. East of the Appalachians the moisture from the Atlantic keeps the country well supplied—the rainfall being generally 45–50 inches in the south, and 40–45 in the north. The effect of the Appalachians is to increase the rainfall on the borders but to decrease the rain in the interior of the mountain region. Thus there

[1] See the reproduction in the *Mo. Weather Rev.*, July, 1917, Vol. 45, Pl. 76.

[2] *Ibid.*, pp. 338–345.

are local maxima of over 50 inches on the slopes well exposed to moist winds; but minima of less than 40 inches in the valleys. The extremes are over 80 inches on the exposed southern face of the Appalachians where North Carolina, South Carolina and Georgia meet; and under 30 inches in the enclosed Champlain valley. Without the abundant moisture which sweeps northward unobstructed all the way from the Gulf of Mexico, the Great Lakes could hardly exist. Since they are present, they exert a local effect on the climate; and increase the rainfall by perhaps 5 inches, making the total thereabouts 35 inches. Contrasts between windward and leeward shore rainfalls are not marked, for the light precipitation which occurs frequently with the cool westerly winds, and the heavy rainfall which comes with the less frequent easterly winds nearly balance. Of the well-watered eastern half of the United States, Professor W. M. Davis says:

> The world hardly contains so large an area as this so well adapted to civilized occupation.[3]

West of the 95th meridian, the rainfall lines run north and south instead of east and west, as is the case to the east. At about the 100th meridian the rainfall becomes too small for ordinary methods of farming, being less than 20 inches in the north and under 25 inches in the south. From here west to the Rockies the rainfall decreases almost to ten inches; so the Great Plains region is one of grazing, dry farming, or local irrigation. In the outlying highlands and the mountain front, the rainfall again rises to 15 or 20 inches. In comparison with the heavily forested east this open country was easily—in some areas, too easily—settled; but the fluctuations of rainfall in this marginal region make man's hold too precarious to favor a dense population.

The Interior Plateau and Basin region, walled off by high mountains, is arid. The rainfall of the northern Rockies exceeds 40 inches in Idaho, but is under 30 inches elsewhere; the central Rockies locally enjoy more than 30 inches, but the high plateaus of the south receive but 15 to 25 inches. The lower mountains and plateaus and the valleys in the rain-shadow of the Cascades and Sierras are arid, with less than 10 inches of rainfall. This aridity becomes extreme in the south; there, with lesser cyclonic activity, and greater heat, the rainfall averages under 5 inches a year. Water for the irrigation of these driest regions is not altogether lacking, for, except in the south, they occur in the lee of the wettest mountains. Thus, the Cascades with rainfall 10–15 times as great as that in the Yakima valley, supply abundant water for this great orchard.

The cause of aridity in the rain-shadow of the Cascades and Sierra Navadas is apparent from a glance at the excessive rainfall on the western side of the coast ranges and these higher mountains. South to the 40th parallel the rainfall exceeds 80 inches, and on the west flank of the Olympics, even 120 inches. In California, the rainfall decreases rapidly southward, while on the mountains of southern California, the amounts are under 30 inches, and on the coast at San Diego even less than 10. The cause of the heavy rainfall is the rapid cooling of the moist air which is blowing almost continuously from the Pacific. This cooling is brought about (1) by the expansion of the air as it is forced to rise over the obstructing mountains; (2) by the similar cooling as this air rises in the numerous cyclones; and (3) by cooling to the cold ground in winter. Diminishing cyclonic activity and increasing warmth of the land cause a southward tapering of the rainfall. The trough between the coast ranges and the higher mountains on the east receive only half as much rainfall as the mountains on either side; thus in many parts of the valleys irrigation is necessary particularly in the San Joaquin valley and in southern California. Water is supplied abundantly by the slow-melting mountain snows. Unlike the eastern United States, then, the western United States has sharp contrasts of rainfall in short distances; and because the rainfall is excessive on the moun-

[3] "Elementary Meteorology," Boston, 1894, p. 301.

tains, where it is not needed for agriculture, it is deficient on the lowlands, where man has to irrigate. However, the aridity of parts of the West has some compensation in the extensive forests of tremendous trees on the soaking slopes of the Pacific.

SEASONAL DISTRIBUTION OF RAINFALL

In some respects, the distribution of rainfall throughout the year is more important than the amount. On this depends the rainfall usable for agriculture, and likewise the effects of rainfall on soil. Thus the 25 inches of rainfall in Nebraska are as useful for crops as 40 inches in Virginia. In fact, the extra 15 inches in Virginia may do more harm than good, on poorly kept farms at least, by washing and leaching the soil.

Rainfall comes (1) in general cyclonic rains, (2) in local convectional (thunder) showers, and (3) in topographically produced falls. The cyclonic rains are greatest with frequent strong cyclones in regions where there is abundant moisture. The thundershowers are most numerous in mid-summer[4] unless at this time the supply of moisture is not abundant. The topographically produced rains are heaviest when there is the greatest cooling of the moist winds. In the United States, general cyclonic rains on the Pacific coast and in the eastern third of the country are heaviest in the colder months. Thunderstorms are common in summer in the wetter parts of the country west of the Sierra-Nevada-Cascades. Topographically produced rains are important on the Pacific, Gulf and Atlantic coasts, and on the windward sides of mountains; they are essentially early winter rains.

Professor Ward has picked out 14 well-recognizable rainfall types in the United States; and he has made composite curves and discussed each.[5] The rains east of the Rockies tend to be heaviest in summer, and those west, in winter. The type covering the greatest region is the continental "Missouri" type. It has a summer rainy season with a maximum of over 4 inches in June and a minimum of 1 inch in January. This shades off into many types on all sides. The Ohio type may be considered as the Missouri type with 1 to 2 inches of cyclonic rain added through the cold half of the year. The New England type has still more of the cyclonic winter rainfall, with 3 to 4 inches of rain every month. Farther south the Atlantic has an intensification of the July and August rainfall with the very favorable moisture conditions for thunderstorms and with the occasional heavy rain of tropical cyclones. The Tennessee type includes so much rainfall from the strong cyclonic action in February and March that the principal maximum, 4½ inches comes at this time; and there still is the summer maximum.

The Gulf coast is always moist. There are three types of rainfall—different combinations of thunderstorm and cyclonic rains—all with maximum intensity in the warmer half of the year.

In the East Rocky Mountain Foothills type, the rainfall in spring starts off like the Missouri type, but the winter snows are insufficient to supply moisture for increasing thunderstorm rains beyond May. The winters are dry in spite of numerous cyclones, because the air can contain so little moisture at the low temperatures. West of the crest of the Rockies, the moisture from the Pacific is precipitated topographically most in winter. In the plateau region, summer convection, especially before the ground is thoroughly dried, brings another maximum early in summer. In the south, however, the winter precipitation is so light and so soon evaporated that the summer showers do not occur till July when moisture arrives in sufficient quantity from the Gulf of California and the Pacific. On the north Pacific coast where there is much cyclonic activity throughout the winter the maximum comes in December (over 7 inches) when the topographic rainfall tends to be heaviest. In the south, cyclonic activity is more important than the cooling of on-shore winds in producing rainfall, so the heaviest rains in the "Southern Pacific" type occur from January

[4] See *Mo. Weather Rev.*, Vol. 43, 1915, pp. 322–340, 13 charts; and pp. 619–620.

[5] *Geogr. Review*, Vol. 4, 1917, pp. 131–144.

to March. Correspondingly, without cyclones, the summers are practically rainless.

The diverse rainfall types of the United States as well as the essential features of the distribution of rainfall may be held in mind if the essential faetures which produce rainfall are remembered.

CHARLES F. BROOKS

COLLEGE STATION, TEXAS

SPECIAL ARTICLES

A PARALLEL MUTATION IN DROSOPHILA FUNEBRIS

A MUTANT of *Drosophila funebris* Fabr. has recently appeared that is so strikingly similar to a well-known mutant of *D. melanogaster* Meig. (*ampelophila* Loew) that there can be litle doubt that the same mutation has occurred independently in the two species. The new form, called notch, agrees with the notch *melanogaster* in at least eight different respects, as will appear below.

Origin.—A female *funebris* of a stock from Mitchell, S. D., was mated to a male of a stock from New York City. The descendants were mated in pairs for several generations, and no variations were observed except an occasional fly with one of the anterior scutellar bristles missing. Such flies were found also in the uncrossed New York stock. In the line under consideration selection was carried on, in an attempt to increase the percentage of such flies, but no marked result was obtained. In F_8 one pair (5201) produced 35 normal females, 34 notch females, and 36 normal males. The sex ratio here is significant, since an excess of males is more frequent than an excess of females in this species. The pair from which the parents of 5201 came produced 19 females and 31 males, which is not an unusual excess when complete counts are not obtained. In *D. funebris* the males usually emerge in a little less time than the females. This relation is just the reverse of that found in *D. melanogaster*. Evidently the female parent of 5201 was genetically notch. She was not observed to be abnormal, and had been destroyed when her offspring began to emerge. It seems probable that she did not have notched wings, but she may well have had the characteristic veins and acrostichal hairs, since these would more easily have been overlooked.

Description.—Notch *melanogaster* is characterized by having the wings somewhat nicked, more especially at the apical posterior corner. But this character is somewhat variable, being often unlike in the two wings of the same female, and sometimes even entirely absent.[1]

In addition the eyes are often smaller than those of the wild-type flies and somewhat roughened.[2]

Furthermore the veins of notch are somewhat thickened, more especially the apical portions of the second and fifth longitudinal veins. This character is the most invariable and convenient index of the presence of the notch gene. The anterior scutellar bristles of notch are often doubled. The acrostichal hairs are more numerous than those of the wild-type fly, and are irregularly arranged, instead of being in eight fairly definite rows.[3] The notch gene thus produces an unusually large number of morphological peculiarities.

Notch *funebris* agrees in all of the above respects. The wings are nicked in the same way, but are often asymmetrical and sometimes normal; the eyes are often small and roughened; the wing veins are thickened even more than those of notch *melanogaster*, the second and fifth being affected most, and this character being again the most convenient and reliable for purposes of classification; the anterior scutellar bristles are often doubled, in spite of the fact that notch arose in a family selected for the absence of these bristles; the acrostichal hairs are irregularly ar-

[1] See Morgan, 1917, "The Theory of the Gene," *Amer. Nat.*, 51, for figure and a discussion of this variability.

[2] Bridges has shown that notch is probably an allelomorph of the roughened eye known as facet. Metz and Bridges, 1917, "Incompatibility of Mutant Races in *Drosophila*," *Proc. Nat. Acad. Sci.*, 3.

[3] The peculiarity of the acrostichal hairs was not observed here until it was looked for after notch *funebris* was found to have unusual acrostichals.

ranged, but differ from those of notch *melanogaster* in being entirely wanting on each side in a narrow band just inside the dorsocentral row.

The unusual features of notch in *melanogaster* are not limited to its morphological nature. Notch is one of the few dominant mutant genes, and in addition is sex-linked and has a recessive lethal effect. The result is that a notch female gives equal numbers of wild-type and notch daughters and of wild-type sons. Notch males never appear. This is the only known dominant sex-linked gene that is also lethal—except *funebris* notch. We have seen that the original notch culture, 5201, gave the characteristics 1 : 1 : 1 : 0 ratio; and this has been repeated by the notch females produced in that culture, both when mated to their brothers and when mated to unrelated wild-type males.[4]

The striking parallel between these two mutants makes it highly probable that they represent the same genetic change. This view is strengthened by the fact that notch is one of the most frequent mutations in *melanogaster* (known to have occurred seven times), and might therefore be expected to be one likely to occur in another species.

Summary.—Notch *melanogaster* and notch *funebris* agree in the following respects:

1. Wings usually irregularly nicked at tip.
2. Certain veins thickened.
3. Eyes often small and roughened.
4. Acrostichal hairs not in definite rows.
5. Anterior scutellar bristles often doubled.
6. Character is dominant.
7. Gene has a recessive lethal effect.
8. Gene is sex-linked in *melanogaster*, almost certainly so in *funebris*.
9. Mutation is one of the most frequent in *melanogaster*, and the first certain one in *funebris*.

A. H. STURTEVANT

COLUMBIA UNIVERSITY,
May, 1918

[4] It is theoretically possible that *funebris* notch is not sex-linked, but that the gene is dominant in females, lethal in males. This can be determined by finding gynandromorphs, or by finding other sex-linked genes and observing their linkage to notch.

THE KENTUCKY ACADEMY OF SCIENCE

THE Kentucky Academy of Science held its fifth annual meeting at the University of Kentucky on Saturday, May 4, 1918, with Mr. J. E. Barton, vice-president, in the chair. After a brief business session, at which several new members were elected, the following program was presented:

President's address, by J. E. Barton, acting president, "The regenerative forests of eastern Kentucky and their relation to the coal-mining industry." The extensive coal-measures of eastern Kentucky support a valuable forest growth, which is of great usefulness in the mining of coal. At the present time it takes about three acres of timber to mine one acre of coal. The ratio should be nearly one acre of timber to one acre of coal. This condition can be brought about by careful management, which is justified by the fact that the coal supply will last about one hundred years, at present rate of production. Timber can be raised in a thirty-year rotation, of sufficient size and character for mining purposes, by a proper selection of species, an area fully stocked and adequate *protection* against fire and live stock.

Differences in the ossification of the male and female skeleton: DR. J. W. PRYOR.

Scientific education: J. J. TIGERT. The rapid development of scientific agriculture. Education followed agriculture in scientific progress. Scientific procedure dependent upon quantitative measurement. Statistical methods and measurements in education. Standard tests. The measurement of intelligence. Charts and tables showing results of measurements in the Cynthiana schools in 1916–17 and the Lexington schools in 1917–18. Age-grade table, Cynthiana, shows 22 per cent. of pupils retarded. Comparison of promotions in Cynthiana and other American cities shows a larger percentage of promotion in Cynthiana than elsewhere. Ayres Spelling Test in Lexington and Cynthiana shows Lexington three points above the average of 84 American cities, and Cynthiana equal to the average of 84 American cities. Handwriting tests in Lexington and Cynthiana show both these cities below the average city in speed and quality of handwriting. Arithmetic tests in Cynthiana show Cynthiana below standard measured by the Woody Scale. A comparison of boys and girls in spelling and handwriting shows the girls to be superior to the boys.

The effect of manganese on the growth of wheat: J. S. MCHARGUE. After reviewing briefly some noteworthy results obtained by previous investi-

gators on the relation of manganese to agriculture, the author presented results obtained by growing wheat in manganese-free sand and in cultural solutions, with and without the addition of manganese.

Wheat plants grown to within a few weeks of maturity in cultural solutions containing manganese and others of the same age in which the manganese had been omitted, were on exhibition. Where manganese had been added to the cultural solutions the plants were apparently normal in every respect, whereas the plants grown in solutions containing no manganese showed a retarded growth in the blades, stalks and roots, as compared with the plants of the same age receiving manganese. There was evidence of lack of the proper development of chlorophyl in the plants receiving no manganese and the blades of these plants exhibited a drooping appearance in that they were not able to hold themselves erect, which was quite characteristic and not to be observed in any of the plants receiving manganese.

The author concludes from his experiments that manganese plays a more important rôle in the growth of wheat than has hitherto been suspected.

Formation of petroleum: C. J. Norwood. (By title.)

Cryoscopic work with an ordinary thermometer: C. C. Kiplinger. It has been found possible to read small temperature intervals on a common thermometer, within an accuracy of 1/100 degree, by measurements of the parallax on an auxiliary scale equipped with a sliding peep-sight.

Several heretofore troublesome sources of error in the boiling point method of determining molecular weights have been eliminated by using but one point as reference on a thermometer scale, having established this point by the use of a known substance with a high degree of purity. This procedure eliminates the need of a calibrated thermometer.

The use of the parallax method is suggested in the estimation of fractional parts of a scale division on other instruments than the thermometer.

Generalization on the mean-value theorem: H. H. Downing.

Magnolia fraseri: does it occur in Kentucky? Frank T. McFarland.

List of fungi from Kentucky: Frank T. McFarland.

An equation balance: E. L. Rees.

A method of constructing the graph of an equation in which the variables may be separated: E. L. Rees.

Protein metabolism in the growing chick: G. D. Buckner and others. (By title.)

Review and observations on the mosaic disease of tobacco: G. C. Routt. The author reviews the work of other investigators and reports observations of his own upon the disease in experimental plots of different varieties of tobacco. He favors the view that the best way to combat the disease will be to develop a resistant strain of tobacco.

Dr. J. A. Detlefsen, of the department of genetics of the University of Illinois, addressed the academy on "Laws governing the transmission of characters from parent to offspring."

The speaker gave a brief review of the search by investigators for the cause or causes of evolution. He then explained the law for the transmission of mono-hybrids, di-hybrids and tri-hybrids. He presented these laws and illustrated them so well that there was left no doubt in the minds of workers in other fields that great progress has been made in genetics in recent years.

He threw upon the screen the tables giving the result of his own breeding experiments to show how nearly actual counts agree with the mathematical expectation, in the laws of transmission. It is remarkable how nearly actual counts of animals bred agree with the expectation of what, by Mendel's law, they should be.

Among other items of business, a resolution was passed offering the services of the academy to the U. S. government for any war work in which this organization might be of assistance.

Officers were elected as follows:

J. E. Barton, Frankfort, President; P. P. Boyd, Lexington, Vice-president; A. M. Peter, Lexington, Secretary; J. S. McHargue, Lexington, Treasurer.

Alfred M. Peter,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, JULY 26, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COMMITTEE OF ONE HUNDRED

FUNDS FOR RESEARCH IN ASTRONOMY

WHEN drawing up the report upon Research Funds made to the American Association in December, 1915, and subsequently printed in SCIENCE there seemed to the committee to be good reason for believing that it would be advisable to place the data relative to astronomical observatories in a separate article, together with certain additional facts which would be of value to those particularly interested in astronomical research.

For this reason a circular letter of inquiry, dated February 1, 1917, was sent to the principal American observatories asking a reply to the following questions in each case:

1. What are the principal and annual interest of observatory funds available for research as distinguished from teaching and what fraction of the income as far as can be estimated may be credited to research?

2. What are the stated publications of the observatory or other papers indicating the results of researches accomplished?

The replies to this letter are uniformly clear and full. Abstracts of them are given below with data taken in some cases from official publications. It is thought that this form of presentation is preferable to a mere tabulation inasmuch as a more definite idea may thereby be secured as to the conditions which obtain in each of the observatories concerned. Especially does this seem desirable in that those interested in astronomy though not professionally engaged in its pursuit may find a brief but intelligible statement of what provision has been made in this country up to the present for the actual advancement of the science by research.

The undersigned will be glad to receive cor-

rections of any omissions or errors in statement.

Dudley Observatory, Albany, N. Y. Benjamin Boss, Director.

1. Principal of Observatory Funds, $140,000. Interest $6,300, wholly devoted to research, including miscellaneous running expenses.

Appropriation received from the Carnegie Institution (department of meridian astrometry); $29,656 annually is entirely devoted to research, with the exception of $1,500 appropriated for miscellaneous purposes.

2. The researches of the observatory are largely printed in the Astronomical Journal which is published by the observatory, and which is, moreover, a general organ for astronomy in the United States. Researches have also been published separately by the observatory and by the Carnegie Institution, not in serial form.

Amherst College Observatory, Amherst, Mass. David Todd, Director.

1. No funds available for research are possessed by the observatory.

Ten astronomical expeditions have, however, been undertaken by it, eight for total solar eclipse observations. The funds requisite for these were supplied from various sources, among which were the National Academy of Sciences, the United States government and the Alumni of Amherst College.

2. The observatory has no funds available for publication.

The results of the researches referred to above have been published by the Smithsonian Institution and in the Astronomical Journal, the Monthly Notices of the Royal Astronomical Society and the Astrophysical Journal.

Detroit Observatory, University of Michigan, Ann Arbor, Michigan. Wm. Joseph Hussey, Director.

1. Supported by annual appropriations made through board of regents of the university, with occasional gifts from interested friends of the observatory.

2. Investigations are printed in The Publications of the Observatory. Two volumes have been issued thus far.

Students' Observatory, University of California, Berkeley, Calif. Armin O. Leuschner, Director.

1. No endowment devoted exclusively to astronomical research. This is maintained so far as pecuniary aid is concerned by funds available from annual budget of laboratories (about $300 for equipment) and private gifts. About one quarter of the time of members of the staff is available for research. Special grants from university funds are made to individuals on recommendation of a research board. Great aid has been given from the Watson Fund of the National Academy of Sciences.

2. Results of researches are published in Publications and Bulletins of Lick Observatory, and in Memoirs of the National Academy.

The principal need of the observatory, the researches in which are theoretical, is that of trained research assistants and computers, which is now met to some extent by graduate students. "There is a crying need for income from regular endowment. Library facilities are amply available. Many important problems in theoretical astronomy and celestial mechanics can not be tackled until endowed research assistantships are available. The country needs a bureau for theoretical research, for numerical investigation of problems of motion, solar and stellar systems, including in the latter binaries, visual, spectroscopic, variable, etc. This important branch of astronomical science is sadly neglected. It should be kept apace with the work of the great observatories."

Harvard College Observatory, Cambridge, Mass. Edward C. Pickering, Director.

1. Principal of funds, July 1, 1915, $860,659.03. Income for preceding year, $53,808.15. Entire income is devoted to research.

2. Publications:

Annals, quarto, of about two hundred fifty pages each; seventy-seven volumes are complete, six in process of publication.

Circulars, quarto, one to four pages, two hundred issued.

Bulletins, octavo, one page, six hundred twenty-four issued.

Annual Report, octavo, ten to fifteen pages, last issued the seventieth.

Several Reports of the Visiting Committee and numerous miscellaneous pamphlets, generally octavo.

Students' Astronomical Laboratory, Harvard University, Cambridge, Mass. Robert W. Willson, Professor of Astronomy.

1. Is primarily intended for teaching the science to undergraduate and graduate students. A certain amount of research is carried on, but no stated appropriation therefor is made.

Leander McCormick Observatory, University of Virginia, University, Charlottesville, Va. Samuel Alfred Mitchell, Director.

1. No permanent research fund. There are at present available for research and thus used the "Special Adams Fellowship" from Columbia University for five years, giving $1,000 per year, devoted to determination of stellar parallax by photography; and temporary grants from the Smith Fund of the National Academy of Sciences, for meteor research, that for the present year being $300.

2. The Publications of the Leander McCormick Observatory now in its second volume.

University Observatory, University of Cincinnati, Cincinnati, Ohio. Jermain G. Porter, Director.

1. No definite provision made for research.

Laws Observatory, University of Missouri, Columbia, Mo. Robert H. Baker, Director.

1. No definite income specially devoted to research. A certain amount is available for appropriations for laboratory purposes in connection with teaching.

2. Publications: Laws Observatory Bulletin, printed at expense of university. Twenty-eight numbers issued thus far and three additional are in press (February 26, 1917). These are paid for out of the general printing fund of the university.

The observatory has under way the investigation of a list of eclipsing variable stars by the extra-focal photographic method. The photographic results already accumulated are far in advance of measurements and computations, so that there is great need of funds for securing suitable assistance for these purposes.

Emerson McMillin Observatory, Ohio State University, Columbus, Ohio. Henry C. Lord, Director.

1. No funds available for research as distinguished from teaching.

2. No stated publications.

Dearborn Observatory, Northwestern University, Evanston, Ill. Philip Fox, Director.

1. Research Fund of $1,500; a gift from the Chicago Astronomical Society.

Maintenance of observatory and salaries met by the university. Annual appropriation for equipment of $500. It is estimated that about half of salary appropriations, amounting at present to $4,975, may be credited to research.

2. Earlier researches have been published in various astronomical periodicals, which will continue to be the case to a certain extent.

One volume of Annals of the Dearborn Observatory published thus far, and it is expected to issue others later.

Lowell Observatory, Flagstaff, Arizona. Guy Lowell, Trustee.

1. Constitution of astronomical staff and amount of funds available for research are not at present determined pending the settlement of the estate of the late Professor Percival Lowell.

2. Publications:

Lowell Observatory Annals.

Lowell Observatory Bulletins.

Lowell Observatory Memoirs.

Lowell Observatory Observation Circulars.

Results of observations are frequently published in astronomical journals.

Shattuck Observatory, Dartmouth College, Hanover, N. H. John M. Poor, Director.

1. Aside from salary of director for teaching paid by trustees of the college, there are available annually $100 from "Library" Fund and $400 income from permanent fund of $10,000 for instrumental and library equipment. The college has at times paid a graduate student for part-time service as a computer. "The one thing needed here is assistance to do computing and routine work," the lack of which holds back greatly the progress of research which otherwise might be carried out.

2. The observatory has no stated publications. Papers from it have been printed in the Astrophysical Journal and Astronomische Nachrichten.

Cornell University Observatory, Cornell University, Ithaca, N. Y. Eugene E. Haskell, Dean of College of Civil Engineering.

1. The new observatory is but recently completed. There is no endowment for research. The work at present is almost wholly instruction.

Washburn Observatory, University of Wisconsin, Madison, Wis. George C. Comstock, Director.

1. No specific fund available for research.

2. Publications of the Washburn Observatory. Twelve volumes issued.

Van Vleck Observatory, Wesleyan University, Middletown, Conn. Frederick Slocum, Director.

1. No special research fund as yet provided, as it is only a short time since the new observatory was finished.

2. Results of the researches of the director have been published in various astronomical and astrophysical journals.

Lick Observatory, University of California, Mount Hamilton, California. William W. Campbell, Director.

1. Devoted exclusively to research. There is no formal teaching. Several graduate fellowships are

maintained by the university, the holders of which, usually for three years, are in training for professional astronomers. In the last year of their fellowship they habitually devote their whole time to their own investigations as a basis for their Ph.D. thesis. There is also available for a like purpose the Martin Kellogg Fellowship, income $1,200 per annum, the holder of which must have received the degree of Ph.D. or its equivalent.

The observatory is mainly supported by an annual appropriation from the regents of the university of approximately $33,000.

The D. O. Mills Expedition to the Southern Hemisphere, a temporary branch of the Lick Observatory, is maintained by direct personal gifts from friends of astronomy amounting to about $7,000 per year.

2. The researches of the Lick Observatory are printed in the following:

Publications, Vols. I.–XII., 4to, 1887–1914.
Bulletins, Vols. I.–IX., 4to, 1901–1917.
Contributions, 8vo, Nos. 1–5, 1889–1895 (now discontinued).
Moon Atlas, 1897.

Maria Mitchell Observatory, Nantucket, Mass. Margaret Harwood, Director.

1. Principal of Observatory Funds, $38,100; annual interest $1,730 approximately. Nine tenths of the income may be credited to research.

2. Results of researches are published by the Harvard College Observatory in its Annals.

Winchester Observatory, Yale University, New Haven, Conn. Mason F. Smith in charge.

1. No teaching is done at the observatory. The total funds, $450,000, are applicable to research and maintenance but are at present subject to large annuity charges. Income for 1916 was $13,000.

2. Researches are printed from observatory funds as memoirs.

Columbia University Observatory, New York, N. Y. Harold Jacoby, Professor of Astronomy.

1. Participates in research funds of the university.

Smith College Observatory, Smith College, Northampton, Mass. Harriet W. Bigelow, Professor of Astronomy.

1. No endowment for research. "Computing Fund" of $100 annually is used for assistance in preparing observations of the observatory for publication. Work is limited closely to teaching.

2. "Comet Observations" from the observatory have appeared in the Astronomische Nachrichten and the Astronomical Journal, in about fifteen numbers.

Goodsell Observatory, Carleton College, Northfield, Minn. Herbert C. Wilson, Director.

1. No funds specifically devoted to research.

For several years past the college has made appropriations of small amounts for this purpose. Aid ($650) has also been received during the past two years from the Watson Fund of the National Academy of Sciences, to assist the work of the director in determining the photographic positions of asteroids.

2. Five numbers of Publications of the Goodsell Observatory have been issued, 1890–1917, the cost of which has been defrayed mostly by private subscription, and in part from the earnings of the magazine Popular Astronomy. The college will publish future researches if not too costly.

Wheaton College Observatory, Wheaton College, Norton, Mass. Laura M. Lundin, Assistant Professor of Mathematics, in charge.

1. At present devoted wholly to purposes of instruction.

Dominion Astronomical Observatory, Ottawa, Canada. Otto Klotz, Director.

1. Work of observatory is wholly research and is supported by direct vote of public money.

2. Publications of the Dominion Astronomical Observatory issued from time to time.

Mount Wilson Solar Observatory, Pasadena, California. George E. Hale, Director.

1. Appropriation from Carnegie Institution for 1917, $178,294, entirely devoted to research.

The appropriation stated above includes salaries, current expenses and provision for considerable additions to buildings and equipment, including completion of 100-inch telescope.

2. Publications:

1. Short Communications, which appear from time to time in the Proceedings of the National Academy of Sciences.
2. Longer Contributions, most of which appear in the Astrophysical Journal. Six volumes of Contributions have already been published.
3. Publications in quarto form, issued by the Carnegie Institution of Washington, containing the details of extensive investigations. Few publications of this character have yet been issued.

Flower Astronomical Observatory, University of Pennsylvania, Philadelphia, Pa. Eric Doolittle, Director.

1. No funds especially assigned to research as distinct from teaching, though a large part of the labor of the director and his assistant is devoted to research.

2. Publications of the Flower Astronomical Observatory.

Three complete volumes, each consisting of three parts, have been issued, and also Part 1 of a fourth volume.

Various papers by members of the staff are published in astronomical journals.

Allegheny Observatory, University of Pittsburgh, Pittsburgh, Pa. Frank Schlesinger, Director.

1. The institution is wholly devoted to research. Annual income at present is $13,500.

2. Publications of the Allegheny Observatory contain most of its researches. Occasional papers published in Astrophysical Journal, Astronomical Journal, etc.

Vassar College Observatory, Poughkeepsie, N. Y. Caroline E. Furness, Director.

1. Research fund, $2,000, yielding about $100 per annum, and not available for academic work or apparatus for students.

2. Publications of Vassar College Observatory. Three volumes have thus far appeared.

Princeton University Observatory, Princeton, N. J. Henry Norris Russell, Director.

1. Total funds appropriated as follows:

Thaw Fellowship, principal $10,000, annual income $500.

Annual gift for research of $1,000 from Mr. A. D. Russell promised until 1919.

Half of annual budget of department from university, which may be credited to research, a minimum estimate, $3,200.

Total, $4,700 per annum.

2. Contributions from the Princeton University Observatory. Four numbers thus far published—300 quarto pages—dealing with variable stars.

Articles published in Astrophysical Journal, Astronomical Journal, Monthly Notices R. A. S. and other journals.

The material published by the Observatory during the past five years amounts to very nearly 500 pages, dealing with variable stars, especially eclipsing variables, stellar statistics and evolution, planetary albedo and various other subjects.

Ladd Observatory, Brown University, Providence, R. I. Roland G. D. Richardson, Acting Director.

1. Is devoted to teaching only.

Blue Hill Observatory, Harvard University, Readville, Mass. Alexander McAdie, Director.

1. Devoted wholly to research. Research fund of $50,000, yielding income of $2,300 annually, applicable to maintenance of observatory and research.

2. Results of investigations published in the Annals of Harvard College Observatory.

Sayre Observatory, Lehigh University, South Bethlehem, Pa. Charles L. Thornburg, Professor of Mathematics and Astronomy.

1. None.

2. No stated organ of publication for occasional papers.

John Payson Williston Observatory, Mount Holyoke College, South Hadley, Mass. Anne S. Young, Director.

1. No permanent funds available for research.

2. Work accomplished, a portion of which has been in cooperation with workers in some other observatory, has been published in various places.

Sproul Observatory, Swarthmore College, Swarthmore, Pa. John A. Miller, Director.

1. No permanent research funds.

The work of the observatory is chiefly carried on by teachers of the college and is sustained by appropriations from the college and outside sources.

2. Publications of Sproul Observatory. Four numbers issued, chiefly devoted to stellar parallax.

Department of Astronomy, University of Arizona, Tucson, Arizona. Andrew E. Douglass, Professor of Physics and Astronomy.

1. Department of astronomy is in process of organization.

The university possesses a fund of $10,000, the income of which is available for the purchase of instruments of precision.

A certain amount of astronomical research is in progress.

University of Illinois Observatory, Urbana, Ill. Joel Stebbins, Director.

1. Observatory is supported entirely by current appropriations from university.

Of these $3,000 per annum, including proportion of salaries and expenses, may properly be charged to research.

2. Scientific results published principally in Astrophysical Journal.

Dominion Astrophysical Observatory, Victoria, B. C. J. S. Plaskett, Director.

1. This observatory is devoted entirely to re-

search and no teaching is engaged in. It is supported by the Dominion Government, but as it is only very recently established, and is neither fully equipped nor staffed, its income is not yet fixed. The sum of $7,500 was granted for maintenance and additional equipment, and from this the salaries of secretary and engineer have to be paid. Salaries of the scientific staff are provided from a separate vote, so that the total income for the current fiscal year may be put at $13,000.

2. The work of the observatory will be issued in the form of separate publications as completed. These will probably be printed at the Government Printing Bureau, and their cost will be charged against the maintenance appropriation.

U. S. Naval Observatory, Washington, D. C. Admiral Thomas B. Howard, U. S. N., Superindent.

1. Work of the observatory is entirely provided for by appropriations made by Congress. This covers observational data for and preparation of astronomical tables and other material and publication of the American Ephemeris and Nautical Almanac, provision of a longitude station, distribution of correct time, the care of all navigation instruments for navy, coast guard and lighthouse service. Also, for 1918 the cost of special eclipse expedition.

2. Publications of the U. S. Naval Observatory. Second Series, Vol. IX., now in press. Earlier papers, 1845 to 1891, published in a series of volumes, mostly annual.

Nautical Almanac Office publishes annually the American Ephemeris and Nautical Almanac and the American Nautical Almanac and Astronomical Papers of the American Ephemeris, irregularly. Also an Annual Report.

An Annual Report of the Naval Observatory is also published.

Astrophysical Observatory, Smithsonian Institution, Washington, D. C. Charles G. Abbot, Director.

1. The entire income of about $13,000 per annum is appropriated by annual acts of Congress, and is devoted wholly to research.

Publications comprise:

2. Annual Reports of the Director to the Secretary of the Smithsonian Institution printed in Smithsonian Report.

Occasional papers by members of the staff generally printed in Smithsonian Institution Miscellaneous Collections.

Annals, published by Act of Congress from time to time and printed by the Government Printing Office. Three quarto volumes have thus far appeared in 1900, 1908, 1913.

Whitin Observatory, Wellesley College, Wellesley, Mass. John C. Duncan, Director.

1. No fund for research as distinct from teaching.

2. Papers by members of the staff published chiefly in Astrophysical Journal and Popular Astronomy.

Yerkes Observatory, University of Chicago, Williams Bay, Wis. Edwin B. Frost, Director.

1. Income ($34,000) applied principally to research but in part to teaching. Four fifths, as nearly as can be estimated, of the total income is expended in research.

2. Publications:

Publications of the Yerkes Observatory, quarto. Vols. I. and II. have appeared; Vol. IV., Part 1, is in type and will soon be issued. Parts 1 and 2 of Vol. III. will be sent out at the same time, without further waiting for the completion of the volume.

The Astrophysical Journal, of which the director is managing editor, is employed as the medium of publication of the more important astrophysical work. Astrometric and other observational work, classified under astronomy of position, is published chiefly in the Astronomical Journal, although some communications are sent to the Monthly Notices of the Royal Astronomical Society. Communications of a more popular interest are frequently sent to Popular Astronomy.

The Student's Observatory of the University of Chicago is organized as a part of the general department of astronomy and has no separate appropriations.

Hopkins Observatory, Field Memorial Observatory, Williams College, Williamstown, Mass. Willis I. Milham, Director.

1. No definite provision made for research.

It will be observed from the data obtained that contrary to the impression which is generally prevalent among the public the funds which are directly and statedly available for astronomical research are far from being large. Very few of the observatories are adequately endowed and most of them rely for their maintenance upon regular grants from the universities with which they are connected. While in the case of the greater institutions reasonable support is thus virtually guaranteed, with

the smaller ones there is often much difficulty in securing the funds which are essential to efficient work. A considerable initial equipment may fail to give the results that might be expected because of inability to procure auxiliary apparatus, to secure suitable assistance in making or reducing observations, or to pay necessary expenses of publication.

Furthermore, attention should be called to an important fact which is referred to in some of the more detailed answers to the questions of the circular and which has been emphasized in earlier considerations of the subject of aid for astronomical research made by the chairman of the Committee of One Hundred.

The help most needed in a large majority of cases is found to be that of a trained assistant to aid in any and all the duties which are called for from an astronomer and especially in computing and other routine work. For such purpose a person not subject to the distractions affecting the ordinary graduate student is desirable. To furnish an observatory with well-equipped aid of this character would often increase its output by an amount far in excess of the necessary outlay.

CHARLES R. CROSS, *Chairman, Subcommittee on Research Funds*

GEOLOGICAL TERMS IN GEOGRAPHICAL DESCRIPTIONS

LAST January Dr. John L. Rich, of the University of Illinois—now Captain in the Intelligence Division of the War Department—sent a letter to SCIENCE expressing his regret that no mention of geological dates was made in a geographical article on the "Block Mountains of New Zealand," by Dr. C. A. Cotton, of Victoria College, Wellington. I have been waiting to see if other geologists would support Captain Rich's view, or if any geographers would take sides with Dr. Cotton; but the discussion has not been continued. As Dr. Cotton was more or less influenced in his method of presentation by several conferences that we had on this subject during an excursion with Professor James Park, of Dunedin, across the New Zealand block-mountain district in 1914, I wish to say a few words on the principles that his method of presentation involves.

The first point to bear in mind is that geological science is much more actively cultivated by trained experts, and is therefore much further developed than geographical science. The second point is that the development of geographical science will be best promoted if geographers follow a discipline of their own, by giving the same single-minded attention to geography that physicists give to physics, astronomers to astronomy, philologists to philology, and so on. The third point is that the best methods of preparing geographical descriptions are still in discussion, and hence experiment on various methods, each one consciously analyzed and intentionally adopted for the time being, is a helpful means of discovering the kind of treatment best adapted for various needs.

Cotton's article is an admirable experiment in the analytic, systematic and regional treatment of a geographical problem. It is to be hoped we may have many more pure geographical cultures of this kind. The gain that such articles contribute to the imperfectly developed science of geography fully compensates, in my opinion, for any loss that the omission of geological dates entails upon the thriving science of geology. Cotton's success must therefore not be measured by the dissatisfaction that his article may create among geologists, but by the satisfaction that it creates among geographers. They should recognize that this excellent study gives, after a careful historical review of the problem under discussion, a critical analysis of the origin of the Block Mountains; that the results of the analysis are systematized or standardized sufficiently for New Zealand needs; that the systematized standards are effectively used in the final pages on regional description; and that the graphic illustration of all its parts is exceptionally good. The only adverse comment that I am disposed to make is that the unlikenesses of the three phases of work, analytic, systematic and regional, are hardly enough emphasized to impress them upon the reader; and that the introduction of some

local examples in the systematic pages and of some explanatory discussion in the regional pages results in blending the two styles of treatment undesirably. I venture to make the further suggestion that a one-page regional summary at the end of the article would have made its results more readily available to geographers in general, and would have at the same time serve as a disciplinary test of the success of all the preceding pages; for geographically speaking, it is in order to prepare such a concise explanatory description of existing forms that the analytical study of their origin and the systematization of the results of analysis are attempted.

The protests that I have made on various occasions, when urging that geographers should develop a scientific discipline of their own, have not been primarily directed against the inclusion of geological terms and items, as such, in a geographical article, for if a geographer wishes to introduce such extraneous matters, not for the benefit of the other geographers whom he is addressing, but for the satisfaction of such geologists as may honor him by their attention, he is surely free to do so although it is difficult to see how he is thereby cultivating or developing geographical science. My protests have been chiefly directed against the use of geological terms in geographical descriptions, where geographical terms are more serviceable.

For example, a recent geographical lecture on northeastern France, published in the *Scottish Geographical Magazine*, described the "escarpments," which dominate the relief of the region between Paris and the Vosges, by the time-names of the geological formations which maintain them. Surely a directly geographical statement of the composition, thickness and attitude of the cuesta-making series of strata would have been more helpful, for it is geographically immaterial when the strata were deposited: but although the lecturer is primarily a geographer, a geological terminology was employed. It is further significant of the immature condition of geography that this well-informed lecturer, addressing a geographical audience in Great Britain on the geography of the neighboring country of France, found it advisable to introduce an elementary explanation of physiographic features so simple as cuestas, as if they were unknown both in kind and in place, and yet did not feel it necessary to give explanatory definitions of technical geological terms such as Triassic and Jurassic! If a geographical audience is not familiar with the physiographic features that are ordinarily associated with a gently dipping series of harder and softer stratified formation, let them be explained by all means; but let the explanation be in pertinent geographical terms, and not in terms so irrelevant as the geological dates when the formations were laid down.

Several years ago the *London Geographical Journal* published an account of a district in central England in an article which purported to be geographical—otherwise it could hardly have found a place in that journal—and which apparently aimed to represent modern methods in scientific geography, but which must certainly have worked to the disadvantage of true geographical discipline; for its introductory pages abounded in remotely irrelevant geological speculations presented in technical geological parlance, and some of its later pages were occupied with painstaking enumerations of plant species, doubtless botanically correct, but not helpful geographically because they did not enable the reader, even if he were as expert a botanist as the writer, to make a correct mental picture of the plant assemblages by which the land forms are covered. The direct description of the landscape, the prime responsibility of a geographical essay, was much less thorough than the geological speculations or the botanical enumerations. Many a British geographer of the old school must have been confirmed, on reading this article, in his disinclination to exchange the empirical method of geographical description, with which he had been familiar from boyhood for the more modern explanatory method; for he would have exclaimed: "If these pages, with their irrelevant geological hypotheses and their detailed lists of botanical species illustrate the modern ex-

planatory method of geographical description, I want none of it!"

It is not only geological terms, but geological habits of thought, that should be avoided in geographical descriptions. For example, an account of a district in northern Africa, published in *La Géographie*, the journal of the Geographical Society of Paris, six or more years ago, included the statement that a certain locality is traversed by a fault, which brings two unlike geological formations together; but nothing was said as to the physiographic expression of the faulted structure. The reason for this silence was, plainly enough, that the author was a geologist who did not distinguish between the geological and the physiographic treatment of faults; he was interested in internal structure, as a geologist must be but he did not extend his interest, as a geographer should, to the point of showing how internal structure, acted upon by exterior forces for a shorter or longer period of time, influence surface form.

Many more examples of the geological habit of thought dominating geographical descriptions are to be found in the employment of the past tense of verbs in the treatment of existing physiographic features. The past tense is eminently fitting in those excellent summaries of physiographic development that are presented in the Geologic Folios of the U. S. Geological Survey, for these summaries are properly enough nothing more than the historic geology of land forms, in which the past tense is fitting. But when physiographic features are presented in geographical descriptions, their treatment should be so devised as to leave the reader vividly impressed with actual land forms as they exist to-day; and nothing is so helpful to this end as the use of verbs in the present tense. In the analytical treatment of physiographic problems, the use of the past tense is unavoidable; and it is for this very reason that analysis should be followed by description, if the best geographical flavor is to be given. It is well enough to say, in the course of analytical investigation, that "the Rahway River was not captured by the Passaic until it had cut a passage across the trap sheets"; but if nothing more is said the reader of such a passage will likely enough be left in the contemplation of the speculative past instead of being brought to realize the actual present.

There is some discussion at present in progress regarding "emergency problems" in education. Geography will, it is to be hoped, have a proper share of consideration. One of its emergency needs to-day is single-minded devotion to its development on the part of its devotees. If there be such a science as geography, let those who pursue it beware of the danger of falling into geological habits of thought on the one side, and into historical habits of thought on the other; let them bring into geography every relevant geological and historical item as freely as geographical items have been carried into geology and history; but let them at the same time conceive and phrase all the items and ideas that are pertinent to their subject in such a way as to give every item and idea a truly geographical flavor, and let them avoid the meretricious method of adding to their geographical articles matter that really belongs elsewhere in the hope of making them more "interesting." If geography can not stand on its own merits, let it fall.

The merit of Cotton's study is, to my reading, that he has striven with praiseworthy single-mindedness to give his subject a purely geographical treatment; his article is therefore a valuable contribution to geographical discipline. He sufficiently indicated the physiographic date of the faulting by which his Block mountains were formed by stating the stage of post-faulting dissection that they now exhibit. He might easily have added geological formation dates for the edification of geologists, petrographical terms for the pleasure of petrographers, and lists of fossils for the benefit of paleontologists, for he is a competent student in all these subjects. He consciously sacrificed these unessential elements in his successful effort to make a contribution to geography alone, as a conscious experiment

in the development of geographical science; and geography profited thereby.

W. M. Davis

Cambridge, Mass.,
June, 1918

ARMAND THEVENIN

The French paleontologist, Armand Thevenin, who lost his life on March 7, at the age of forty-eight years, as a result of experimenting with poisonous gases in connection with the war, will be remembered chiefly for his beautiful memoir on the early vertebrates of France. He was particularly interested during several years in the Coal Measures Amphibia of France and in 1906 under the title "Amphibiens et Reptile du Terrain Houiller de France" he published in the *Annales de Paléontologie* his initial memoir on this subject. In this memoir Thevenin showed a wide acquaintance with the subject of fossil Amphibia and was especially fortunate in the discovery of an interesting and primitive reptile which he described under the name of *Sauravus costei*. This form, as the most ancient reptile of France, is paralleled in America by the form *Eosauravus copei* described by Williston from the Coal Measures of Linton, Ohio.

Four years later appeared Thevenin's monographic contribution to vertebrate paleontology, published with the title "Les plus anciens Quadrupédes de France" in Tome V. of the *Annales de Paléontologie.* This beautifully illustrated and carefully written memoir was awarded a prize by the Academy of Sciences and will now stand for all time as an indication of the ability and ideals of Armand Thevenin. Had his life been spared he doubtless would have given us other memoirs of a like nature, for shortly before the war he was interested in the study of the vertebrate paleontology of Madagascar, of which several studies had appeared in the pages of the *Annales de Paléontologie*. Thevenin summarized the results of his studies on the most ancient vertebrates of France by noting, for both amphibians and reptiles, the diversity of form and structure exhibited by the species which he had studied, suggesting that the vertebrates of the Coal Measures, though very ancient, were still a long way from their origin. A similar conclusion has been reached by students of early vertebrates in America.

Thevenin was fortunate in his association in the Museum National d'Histoire Naturelle with paleontologists of international fame, such as Albert Gaudry and Marcellin Boule and he profited by his association in producing under the stimulus of their influence his interesting studies on fossil vertebrates. His list of papers is not extensive, probably not over a dozen all told, but his work was carefully and well done and he will stand as a worthy worker in the development of vertebrate paleontology. Students of paleontology in the future may gain much by studying carefully the neat and orderly presentation of facts and the beautiful illustrations of his "Les plus anciens Quadrupédes de France" and thus be stimulated to produce better and more carefully wrought pieces of thoughtful endeavor.

Roy L. Moodie

College of Medicine,
University of Illinois

SCIENTIFIC EVENTS

THE KATMAI EXPEDITION OF THE NATIONAL GEOGRAPHICAL SOCIETY

Word has just been received of the safe arrival in the field of this year's National Geographic Society expedition to the Valley of Ten Thousand Smokes. On account of the war and particularly because of the difficulty of securing transportation for a larger party it was deemed advisable to send only two men into the field this year, the director, Dr. Robert F. Griggs, and other members of the expedition remaining behind to work up the unpublished results of the expedition of 1917. The field party consists of Jasper Sayre and Paul R. Hagelbarger, both members of last year's expedition. Their mission is to carry forward reconnaissances into country not reached by previous expeditions and to lay the foundation for more intensive scientific study of the volcanic phenomena manifested in the Valley of

Ten Thousand Smokes, which it is expected to continue after the war.

The party this year entered the region from the Bering Sea side of the Alaska peninsula rather than from the Pacific as heretofore. The ship that carried them, the *Dora*, was one of those caught by the unusually bad ice conditions this spring in Bering Sea and for two days was seriously hampered by the ice floes, which made navigation precarious, but, although warned by the coast guard cutter to turn back, she finally made her way through the ice without mishap. When last heard from on June 10, the expedition was camped at the foot of Naknek Lake prepared to plunge into the wilderness.

THE BROOKLYN BOTANIC GARDEN

ON June 13 the treasurer of the Brooklyn Institute of Arts and Sciences received from two anonymous donors a gift of securities of the par value of ten thousand dollars, as an addition to the permanent endowment of the Brooklyn Botanic Garden, and to be known as the Benjamin Stuart Gager Memorial Fund. At the request of the donors, the income from this fund is to be expended for publications for the library or otherwise as the present director of the garden may designate.

The chairman of the Brooklyn Botanic Garden Governing Committee, Mr. Alfred T. White, has made provision for several prizes for 1918 and annually thereafter. The most important of these prizes is a scholarship of the value of $100 to be awarded to the boy or girl who has taken class work at the Brooklyn Botanic Garden for not less than three years, and who has shown marked ability along botanical and agricultural lines, both at the Garden and in his high-school courses, as attested by his principal and teachers. This will be known as the Alfred T. White Scholarship, and will be awarded for the first time in 1920. Further information may be obtained by addressing the director of the Garden.

Details as to this and some of the other prizes are published in the Brooklyn Botanic Garden *Leaflet* of June 20, 1918. Special mention, however, should here be made of the offer of two first and two second prizes (one for boys and the other for girls) of War Savings Stamps to the value of $15 and $10, respectively, for excellence in back-yard gardens; and of two other prizes (one for boys and one for girls) of $10 each, in War Savings Stamps, for making the best use of a plot of ground in the children's gardens at the Brooklyn Botanic Garden.

In addition to the above, twenty prizes of ten Thrift Stamps each (ten to boys and ten to girls) will be awarded to those who are most generally helpful in connection with the children's garden at the Botanic Garden. Promptness, regularity of attendance, effort, accomplishment and other points will form the basis of this award. The War Savings Stamps and Thrift Stamps will be awarded only for the period of the present war.

THE CHEMICAL WARFARE SERVICE

THE following statement is authorized by the Secretary of War:

The organization of the Chemical Warfare Service has been completed. Henceforth all phases of gas warfare will be under the control of the Chemical Warfare Service commanded by Major-General William L. Sibert.

Heretofore chemical warfare has been carried on by divisions in the Medical Department, the Ordnance Department, and the Bureau of Mines. All officers and men who have been connected with offensive or defensive gas warfare here will be responsible to the Chemical Warfare Service. The field training section at present in under the Corps of Engineers.

Defensive warfare has been under the control of the Medical Department. This work has consisted of the designing and manufacture of masks both for men and animals and the procurement of appliances for clearing trenches and dugouts of gas.

Offensive gas warfare consists principally of manufacturing gases and filling gas shells. The work has been under the direction of the Ordnance Department.

The new department will take over the work

of chemical research for new gases and protection against known gases which has been carried on by the Bureau of Mines. All testing and experiment stations will be under the direction of the Chemical Warfare Service.

The responsibility of providing chemists for all branches of the government and assisting in the procurement of chemists for industries essential to the success of the war and government has been intrusted to the Chemical Warfare Service.

All chemists now in the Army will be removed from their units and placed under the authority of the Chemical Warfare Service. Newly drafted chemists will be assigned to the Chemical Warfare Service.

Authority to assign enlisted men or commissioned chemists to establishments manufacturing for the government has been granted to the new section.

THE ORGANIZATION OF PHYSICIANS FOR WAR SERVICE

The Council of National Defense authorizes the following:

As the first step in a nation-wide campaign to enroll every doctor in the United States in the Medical Reserve Corps of the Army, the Naval Reserve Force, or the Volunteer Medical Service Corps members of the committees of the Medical Section, Council of National Defense, for the states of New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, West Virginia and the District of Columbia met at the Hotel Washington in Washington. At this meeting the state representatives discussed with the representatives of the Council of National Defense details of the plan to be followed and received instructions.

This meeting is the first of a series, the United States having been divided into eight groups. The work will be subdivided among the state and county representatives of the Medical Section, Council of National Defense, in each state, and every doctor in the country who has so far not done so will be asked to apply for membership in the Medical Reserve Corps of the Army, Naval Reserve Force, or the Volunteer Medical Service Corps. Eligible to the Volunteer Medical Service Corps are all those who would be eligible to the Medical Reserve Corps were it not for being over the age of 55, physical disability, community or institutional need, or dependents. Women doctors are eligible to the Volunteer Medical Service Corps.

The states included in the various groups are as follows:

Group No. 1.—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut.

Group No. 2.—New York, Pennsylvania, New Jersey, Delaware, District of Columbia, Maryland, Virginia, West Virginia.

Group No. 3.—Michigan, Ohio, Kentucky, Indiana, Illinois, Wisconsin.

Group No. 4.—Louisiana, Tennessee, North Carolina, Georgia, South Carolina, Florida, Alabama, Mississippi.

Group No. 5.—Iowa, Minnesota, North Dakota, South Dakota, Nebraska, Montana, Wyoming.

Group No. 6.—Missouri, Arkansas, Kansas, Oklahoma, Texas, Colorado.

Group No. 7.—Washington, Oregon, Idaho.

Group No. 8.—Utah, Nevada, California, Arizona, New Mexico.

By authority of Surgeon-General Gorgas, of the Army; Surgeon-General Braisted, of the Navy; and Surgeon-General Blue, of the United States Public Health Service; Dr. Franklin Martin, chairman of the general medical board of the Council of National Defense, has appointed the following committee on classification of the medical profession of the United States for military and civil purposes. Colonel R. B. Miller, Marine Corps, United States Army; Colonel V. C. Vaughan, Marine Corps, National Army; Lieutenant-Colonel H. D. Arnold, Marine Corps National Army; Surgeon R. C. Ramsdell, United States Navy; Surgeon J. R. Phelps, United States Navy; Dr. Joseph Schoreschowsky, United States Public Health Service; Dr. Otto P. Geier, Dr. John D. McLean and Dr. C. E. Sawyer. Ex officio: Surgeon-General W. C. Gorgas, United States Army; Surgeon-General W. C. Braisted, United States Navy;

Surgeon-General Rupert Blue, United States Public Health Service; Lieutenant-Colonel F. F. Simpson and Dr. Franklin Martin.

This committee is authorized to meet at regular intervals and to cooperate with the committee on states activities, the state and county committees, and other agencies and societies engaged in advisory or executive functions dealing with classifications and enrollment for military, industrial and home needs.

THE STERLING BEQUEST TO YALE UNIVERSITY

THE residuary estate of John W. Sterling, which it is said will amount to $15,000,000, has been left by the terms of his will to Yale University. Mr. Sterling, who was of the law firm of Shearman & Sterling, died on July 5 while staying in Canada at the fishing lodge of Lord Mount Stephen. Of the remaining $5,000,000, $1,000,000 goes to the Miriam A. Osborn Memorial Home at Rye, N. Y., and $4,000,000 to relatives, friends, employees and charities. The clause which gives the residue of the estate to Yale University is this:

All the rest, residue and remainder of my estate not hereinbefore effectually disposed of, I direct my said trustees to dispose of in the manner following:

To apply the same, as soon after my decease as may be practicable, to the use and for the benefit of Yale University, in the erection in New Haven, Conn., upon land selected at its expense by it with the approval of my said trustees, of at least one enduring, useful and architecturally beautiful edifice, which will constitute a fitting memorial of my gratitude to and affection for my alma mater. The said trustees shall have entire liberty and discretion to apply any portion of the said property or its proceeds to the erection of a single building, and they shall apply the balance of said property, if any, to the erection and equipment of other fine and enduring buildings for the use of students in the academical or graduate departments, and, to some extent, to the foundation of scholarships, fellowships or lectureships, the endowment of new professorships, and the establishment of special funds for prizes.

In case I erect or provide during my lifetime for the erection of such a memorial edifice as is described in the first part of this article XXVIII., my trustees shall not be required to erect an additional memorial building, though they shall have complete power to apply my said residuary estate for the benefit of the said university to the erection of other edifices of a memorial character or to the other purposes specified in subdivision I. All buildings erected as aforesaid shall be made fireproof and shall be constructed in the most substantial manner.

Mr. Sterling was graduated from Yale in 1864. His bequest is the largest ever made to an American university, and the amount has only been exceeded by the gifts of Mr. Rockefeller to the University of Chicago and of Mr. and Mrs. Stanford to Stanford University.

MEMORIAL TO JOSIAH ROYCE

SOME of the personal friends and colleagues of Josiah Royce, who believe that his work and his character made a deep impression upon a wide circle of men and women, and that he became in fact the center of a large spiritual community, many of whose members were unknown to him, as he was unknown personally to them, feel that the reverence and affection which went out to him as a thinker and as a man should be embodied in some appropriate memorial of him at Harvard University, where he expressed himself in characteristic speech and writing for thirty years.

It is proposed, with this end in view, to create a fund of $20,000, to be known as the Josiah Royce Memorial Fund, the income of which shall go to Mrs. Royce during her lifetime, and thereafter to the department of philosophy of Harvard College, to be used in such ways as the department shall decide from year to year.

There are evident reasons why this appeal should not be delayed until the return of normal conditions, natural as such postponement might on some accounts appear to be. And further, the due honoring of our moral heroes, though a privilege under all circumstances is

especially a privilege and a duty in heroic times.

Those who desire to subscribe may send their checks to Charles Francis Adams, Esq., treasurer of Harvard College, 50 State Street, Boston.

CHARLES W. ELIOT,
CHARLES P. BOWDITCH, president, American Academy Arts and Sciences,
JOHN GRIER HIBBEN, president, Princeton University,
R. F. ALFRED HOERNLE, chairman, Department of Philosophy and Psychology, Harvard University,
LAWRENCE J. HENDERSON, secretary, The Royce Club,
JAMES J. PUTNAM, M.D.
E. E. SOUTHARD, M.D.
WILLIAM ERNEST HOCKING

SCIENTIFIC NOTES AND NEWS

PROFESSOR A. A. MICHELSON, head of the department of physics, University of Chicago, has been commissioned as lieutenant-commander in the navy.

DR. RICHARD C. MACLAURIN, president of Massachusetts Institute of Technology, has accepted the appointment of director of college training, in charge of the Students' Army Training Corps under the War Department's Committee on Education and Special Training aiming to mobilize the higher institutions of learning.

PROFESSOR JULIUS STIEGLITZ, chairman of the department of chemistry at the University of Chicago, has been appointed as special expert in the United States Public Health Service of the Treasury Department. This will not involve his work at the university. The government assigns him two assistants, who will be in the employ of the Public Health Service and will carry out their work in Kent Chemical Laboratory under Professor Stieglitz's direction.

MAJOR ANTON J. CARLSON, chairman of the department of physiology at the University of Chicago, who is now in the Sanitary Corps of the National Army attached to the Food Division of the Surgeon General's Office, is at present on duty in England, making a study of food conditions in the rest camps of the United States Army.

M. K. AKERS, professor of applied electricity, at the State College of Washington, has been granted leave of absence for the duration of the war. He is now conducting research work in the development department of the Western Electric Company of New York. Harry L. Cole, instructor in chemistry at the State College of Washington, has been recommended for leave of absence during the period of the war, and is now training in the aviation camp at Berkeley, California.

THE Royal Society of Arts has awarded the Albert Medal for 1918 to Sir Richard Tetley Glazebrook, C.B., Sc.D., F.R.S., "for his services in the application of science to the industries of peace and war, by his work as director of the National Physical Laboratory since 1899, and as chairman of the Advisory Committee for Aeronautics." The society's Albert medal, founded in 1863 to commemorate the presidency of Prince Albert, has been awarded annually "for distinguished merit in promoting arts, manufactures and commerce."

OXFORD UNIVERSITY has conferred the degree of master of arts *honoris causa* on John Louis Emil Dreyer, Copenhagen, late director of the Armagh Observatory.

THE Birmingham medal of the British Institution of Gas Engineers, has been presented to Mr. John West, of Southport. Mr. West, who is eighty years of age, has been awarded the medal in connection with his work for the gas industry and Ministry of Munitions.

THE David Livingstone Centenary medal of the American Geographical Society has been awarded to Colonel Candido Mariano da Silva Rondon in recognition of his valuable work of exploration in South America.

MR. HERBERT SAMUEL, M.P., has been elected president of the Royal Statistical Society of Great Britain.

Professor William North Rice, for the past fifty years professor of geology at Wesleyan University, is retiring from active work.

Dr. S. J. Barnett has resigned his post as professor of physics at the Ohio State University in order to accept the position of physicist-in-charge of experimental work at the department of terrestrial magnetism of the Carnegie Institution of Washington. He entered upon his new work at Washington, on July 15.

The series of War Lectures given in July at the University of Chicago include the following: James Rowland Angell, head of the department of psychology, spoke on July 2, on "Psychology in the Service of the Army." On the same date J. Laurence Laughlin, professor emeritus of political economy, discussed "Economic War Lessons for the United States." On July 3 Professor Julius Stieglitz, chairman of the department of chemistry, discussed "Chemistry as a Factor in Modern Warfare." On July 5 Dean Rollin D. Salisbury, of the Ogden Graduate School of Science, presented "The Contributions of Geology to the War." On July 9 "Infectious Diseases and the War" was discussed by Edwin Oakes Jordan, chairman of the Department of hygiene and bacteriology.

The faculty of the school of medicine of the University of Pittsburgh, have passed the following resolution in appreciation of Dr. R. E. Sheldon, who died on July 9:

Through the sudden death of Dr. Ralph Edward Sheldon, professor of anatomy, the school of medicine of the University of Pittsburgh has lost one of its efficient teachers, an indefatigable worker, and a man of resolution who has reaped abundant success. Dr. Sheldon's death has closed an active career, which was ascending to its acme in the mid-period of life. His work in the special field of neurology was gaining for him an eminent place with the leaders in this branch of research; his enthusiasm in building up his department was unbounded and his wide interest in the sphere of higher education was ever active. His colleagues deeply appreciated him in his work and as a loyal and trusted friend, and closely followed the growth of his successors. The medical faculty look forward to the publication of his book on neurology which will stand as the monument of his efforts.

Be it resolved that this appreciation of affection from his colleagues and associates be entered upon the minutes of this faculty meeting and the expression of their deep sorrow at his loss be extended to the members of his family.

Dr. Richard Rathbun, since 1897 assistant secretary of the Smithsonian Institution, and since 1899, in charge of the National Museum, died on July 16, aged sixty-six years.

Professor Pozzi, a distinguished gynecologist and surgeon, on June 13, at the age of seventy-two years, was murdered in his consulting room by a lunatic patient, who thereupon committed suicide.

A cablegram was received on July 16 at the Harvard College Observatory from Professor B. Baillaud, director of the Paris Observatory, stating that Wolf's periodic comet was observed by Jonckheere, at Greenwich, in the following position:

July 9.508 G.M.T.
R.A. $20^h\ 35^m\ 13^s$
Dec. $+ 24°$

It was first reported by the Yerkes Observatory in California after an absence of seven years.

The daily papers state that Professor Vincent read recently before the Paris Academy of Sciences a paper in which he described the preparation of a new serum which it is stated has proved effective even in desperate cases of gas gangrene.

A special emergency act to give the government control over all platinum in the United States was recommended by members of the Ways and Means Committee of the House of Representatives on July 1, after hearing further evidence of the short supply of the metal. Chairman Kitchin told the committee he believed the measure should be enacted immediately instead of waiting for the enactment of the revenue bill, which may impose a heavy tax on all platinum users. Members of the committee agreed the situation was serious enough to warrant prompt action to provide a sufficient supply of the metal for war manufacture.

SIR BERNARD MALLET, the Registrar-General of Great Britain, delivered a lecture recently at the Royal Institute of Public Health on "The effects of the war as shown in vital statistics." Dealing with the decline in the birthrate due to the war, he said that in England and Wales the births registered in 1913 numbered 881,890. In 1915 they fell to 814,614. In 1916 there was a further fall to 780,520, the slightness of the fall from the previous year being due to the increase in marriages in 1915, when the number celebrated reached the "record" figure of 360,885. In 1917 the births registered fell to 668,346, a decline from the 1913 figure of 24 per cent. Up to the present there had been lost in England and Wales in potential lives, on the standard of 1913, 650,000. He thought that it would be long before the birth-rate reached the figure that obtained before the war. Serious as this loss is to the coming generations in Great Britain, he continued, there is reason to believe that it had suffered less in this direction than the other belligerent nations. In terms of percentages of loss on the pre-war population it may be assumed that Germany has lost in potential lives the equivalent of 4.5 per cent. of its total pre-war population, Austria 5 per cent., and Hungary 7 per cent. The statement may be hazarded that the present war, by the fall of births it has occasioned, cost the belligerent countries of Europe not less than 12½ millions of potential lives. While the war has filled the graves, it has emptied the cradles. At the present time, every day that the war continues means the loss of 7,000 potential lives to the United Kingdom, France, Italy and the Central Empires.

TECHNICALLY trained men and women are needed for the examining corps of the Patent Office. Those are wanted who have a scientific education, particularly in higher mathematics, chemistry, physics and French or German, and who are not subject to the draft for military service. Engineering or teaching experience in addition to the above is valued. The entrance salary is $1,500. Examinations for the position of assistant examiner are held frequently by the Civil Service Commission at many points in the United States. One is announced for August 21 and 22, 1918. Details of the examination, places of holding the same, etc., may be had upon application to the Civil Service Commission, Washington, D. C., or to the Patent Office. Should the necessity therefore arise temporary appointments of qualified persons may be made pending their taking the Civil Service examination. Application for such appointment should be made to the Patent Office.

OPPORTUNITIES in government work for women include the following, announced by the United States Civil Service Commission: *Bacteriologist:* Vacancies in Public Health Service, at $1,800 a year. Applicants must have graduated from a college or university of recognized standing in a course including biology and bacteriology and have had at least two years postgraduate experience in practical bacteriologic laboratory methods. *Biochemist:* The United States Civil Service Commission announces an open competitive examination for biochemist for both men and women for duty in Washington or elsewhere, at salaries ranging from $1,800 to $3,000 a year. Certification to fill the higher-salaried positions will be made from those attaining the highest average percentages in the examinations. Competitors will not be required to report at any place but will be rated on education and experience and publications or thesis to be filled with application.

THERE are still many elements of uncertainty in the search for oil pools, but some of these are reduced to a minimum in regions where rock outcrops are conspicuous and the relation of the oil pools to the structure of the rocks is relatively simple. These are the conditions in the Big Horn Basin, Wyo., a report on which has recently been published by the United States Geological Survey, Department of the Interior, as Bulletin 656, "Anticlines in the southern part of the Big Horn Basin, Wyo." The report is one of a series on the existing and prospective oil fields of the state, several of which have already been published.

Though oil was known to exist in the Big Horn Basin as early as 1888 and sporadic attempts have from time to time since been made to discover it in large quantities, the production of oil in this region may be said to have begun in 1906, when wells were drilled in the Byron field. Wells were afterwards drilled in several other parts of the basin, and though small quantities of oil and gas have been discovered in fourteen fields, the region is well known largely because of the production since 1914 from the Grass Creek, Elk Basin, Greybull and Torchlight fields. From 1914 to 1916 the production of oil in Wyoming rose from 3,560,375 to 6,234,137 barrels, and a considerable part of this increase has been derived from the fields just named. The report describes fifty anticlines and domes, twenty-seven of which have been tested by drilling. Four of these contain very productive oil and gas fields, and seven contain fields that are less productive and less promising. The anticlines lie in a broad belt around the border of the Big Horn Basin, and the authors of the report conclude that those which are nearest the central trough of the basin offer the greatest prospect for successful drilling. In fact, none of the explored anticlines that are separated from the central trough by other anticlines have yet yielded more than traces of oil and gas. As nine anticlines adjacent to the central trough remain untested there is a good prospect that other productive fields may yet be discovered. The report was prepared by D. F. Hewett and C. T. Lupton.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of Elmer P. Howe, of Marblehead, Mass., after private bequests amounting to between $35,000 and $40,000 are provided for, the residue of the estate is to be divided equally between Yale University and the Worcester Polytechnic Institute for general use. For the purposes of the probate bond the estate is estimated at $30,000 real and $400,000 personal property.

Dr. Charles A. Tuttle has presented to Yale University his home and offices, a large brick building on York Street, adjacent to Wrexham Hall.

According to the Journal of the American Medical Association the number of students enrolled in the medical department of the University of Buenos Aires is over 5,000. In 1917, there were 4,078 enrolled, distributed as follows: medicine, 3,051; pharmacy, 317; doctor in pharmacy, 88; odontology, 428, and obstetrics, 194. Including the departments of law, engineering, philosophy and literature, agronomy and veterinary science, there are a total of 9,521 matriculated students. There are 984 students inscribed in the medical department of the other university in the country, the University of Cordoba.

During the absence of President Harry Pratt Judson, of the University of Chicago, as head of the American Commission for Relief in Persia, the dean of the faculties, Professor James R. Angell, head of the department of psychology, has been designated by the board of trustees as vice-president of the university.

Frank L. De Beukelaer, professor of chemistry at Washburn College, Topeka, Kansas, has been appointed to an instructorship in the department of chemistry at the University of Chicago.

Dr. Cyrus H. Fiske, who has held the position of assistant professor of biological chemistry at Western Reserve University, Cleveland, will join the Harvard medical staff with the same title.

DISCUSSION AND CORRESPONDENCE

THE SUPPLY OF ORGANIC REAGENTS

To the Editor of Science: In order to provide for the supply of organic reagents for research and industrial purposes the Eastman Kodak Company has determined to commence their preparation in its research laboratory.

This decision was arrived at partly as a result of the letters of Dr. Roger Adams and Professor Gortner[1] which drew our attention to the need for an adequate supply of these materials produced by a firm of standing.

[1] Science, March 8, 1918, p. 226 and June 14, 1918, p. 590.

In order to carry on the work a separate section of the laboratory has been established under the title of the "Department of Synthetic Chemistry," which will be under the immediate direction of Dr. H. T. Clarke, well known for his publications on organic chemistry.

In order to meet the need expressed in Professor Gortner's letter and to make available to research laboratories in this country the organic chemicals which they require, it is proposed that chemicals for research work shall be supplied at the lowest possible price. At first, no doubt, this price will necessarily be higher than that charged by the German firms before the war, but it is hoped that eventually the profit made on chemicals supplied for commercial purposes may enable the rarer materials made in small quantities for research work to be sold at a price which will be within the reach of all who require them.

At first, of course, the laboratory will be able to supply only a limited number of substances, and these in small amounts, but the department will be expanded to meet the demand and with the assistance of other laboratories interested in organic chemistry, and of the firms who are producing dyes and intermediates, it is hoped that after a time an adequate supply of synthetic organic reagents can be made available.

It is possible that laboratories may have in stock unusual reagents which they are unlikely to require. If any laboratories possessing such reagents will write to us we shall be glad to make an offer for the materials, thus making them available on the market.

Our thanks are due to many of the chief chemists of the country who have encouraged us to commence this work and especially to Professor Roger Adams for the way in which he has received our proposals and has assisted us by placing at our disposal the information as to this work which he has accumulated.

Communications regarding reagents should be addressed to the Research Laboratory, Eastman Kodak Company, Rochester, N. Y.

C. E. K. Mees

July 11, 1918

FIREFLIES FLASHING IN UNISON

In Science for February 4, 1916, I published a short note entitled "Fireflies Flashing in Unison" in which I gave my own observations with confirmatory notes of K. G. Blair regarding a European species. This note led to a discussion in the pages of Science in which various views were expressed; one writer throwing doubt on the correctness of my observations, another suggesting that I was deceived and the effect psychological, another that it was the result of coincidence and still another giving confirmatory evidence of the phenomenon in question.

In Science for September 15, 1916, I was able through the courtesy of Professor E. B. Poulton of Oxford, to note the advanced pages of a book entitled, "A Naturalist in Borneo," by Mr. S. Shelford, an old student of Professor Poulton. Mr. Shelford describes vividly the synchronous flashing of fireflies he observed in Borneo. In Science for October 27, 1916, Mr. F. Alex. McDermott, who has made a special study of the light emission of American Lampyridæ,[1] has found no periodicity in the phenomenon. In Science for November 17, 1916, Mr. H. A. Allard says:

> The synchronal flashing of fireflies appears to be a very rare phenomenon in North America. So rarely does it seem to occur that one may consider himself fortunate if he has observed the phenomenon once in a lifetime.

His observations were made at Oxford, Mass. A heavy thunder storm had passed over followed by a profound calm, the air was very warm and humid; thousands of these insects were sailing low over the ground flashing incessantly as far as the eye could see. After a while a most remarkable synchronism in the flashing appeared to take place, giving one the impression of alternating waves of illumination and darkness in the distance. Though Mr. Allard had given great attention to the flashing of fireflies since these observations were made twelve years before he had never since observed this phenomenon.

In Science for September 28, 1917, Mr. Frank C. Gates, of Carthage College, from ex-

[1] *Canadian Entomologist*, Vols. 42, 43, 44.

periments made on two specimens in a tent with a flashlight and observations made in the Philippines concludes that the synchronism in the flashing of a group of fireflies is accidental and of very rare occurrence

Mr. Olaf O. Nylander, of Caribou, Me., to whom I sent a copy of my firefly article, in a letter dated October 8, 1916, says that a number of years ago, while walking from Caribou Mills to his home, he noticed in a small clearing the greatest assembly of fireflies that he had ever seen; the ground and stumps were fairly aglow. The flashes were not perhaps as regular as an army officer would like to see in regimental drills but were so rhythmic that any one would take note of their action. He also observed that the air was very damp at the time.

In *The Scientific American* of January 19, 1918, Mr. John V Purssell, of Washington, D. C., records that

> In the town of Cotabato, Island of Mindanao, P. I., a few years ago, there were two trees about the size of apple trees, and perhaps a hundred feet apart, and every evening these were filled with fireflies which flashed in synchronism, first one tree lighting up and then the other. There must have been several thousand insects in each tree, yet the synchronism was so perfect that rarely or never did a single firefly flash at the wrong time.
>
> To the best of my recollection the illuminated period lasted about two or three seconds and the dark period perhaps twice that long. I can positively vouch for the accuracy of the foregoing for it seemed so strange, and produced so beautiful an effect that I thought it one of the most remarkable things in the Philippines, and it made a deep impression on me.

The independent observations of this synchronism in the flashing of fireflies by the author in Gorham, Me.; K. G. Blair in Europe; S. Shelford in Borneo; Dr. H. C. Bumpus near Woods Hole, Mass.; H. A. Allard in Oxford, Mass.; Olaf O. Nylander in northern Maine and John C. Purssell in Mindanao, Philippine Islands, are I think quite sufficient to establish the fact that these insects do at times flash in unison. The rarity of the occurrence is a mystery.

In this connection a coincidence might explain a well-known occurrence in a small group of individuals, as at a dinner party when they all cease talking for an appreciable time, but would not explain the quiet pause which one sometimes observes in a large dining hall containing hundreds of diners. I discovered the cause of this phenomenon some years ago. While dining with a number of friends at the Parker House the guests at a neighboring table had been noisy, even boisterous, doubtless we had been somewhat noisy too. The neighboring table suddenly became quiet and we stopped talking to see if the noisy ones had gone, but they were still there, other tables looked about for the pause and this hush spread rapidly through the hall. Dear old Dr. Virchow had often observed this pause and thought my explanation correct. He also told me that it was a saying in his country that when this hush occurred an angel was passing through the room, also that a lieutenant was paying his debts! So in regard to fireflies a dozen or more might flash for awhile in unison as a coincidence, but when thousands are observed to flash in unison no doctrine of probability or chance can account for it.

EDWARD S. MORSE

SALEM, MASS.,
July 2, 1918

THE VERO MAN AND THE SABRE TOOTH

IN determining the relative antiquity of the Vero man and the fossil plants and animals there associated, certain larger factors yet require attention. The direct evidence has been minutely examined from varying points of view: geologic, paleontologic, anthropologic. It seems conclusive that the man of Vero reached one of the last lairs of the sabre-toothed tiger, as Dr. Hay contends; while Berry discloses a degree of change in the local flora not to be ignored. But, on the other hand, the anthropologists show that the accompanying artifacts are like those elsewhere recent.

Perhaps the anthropologists have the best of the *argument,* as such. Florida has retained much its present outline since the close

of the Eocene, sometimes a little below the ocean level, never far above. Geologic change has been at no time great enough to prevent the easy reentrance of the sub-tropic vegetation, persistent in the United States at three points only—the Lower Colorado, the Lower Rio Grande, and the lower part of the "spruce pine," and *Pinus heterophylla* sections of Florida. In each of these widely separated regions larger continental features tend to create and maintain melior climatic conditions. The Colorado cuts deep, and holds its valley protected from the cold. The gulf warms the low coastal strip markedly as far north as the mouth of the Rio Grande; and Florida, though flung well out to sea, so blocks the warmer gulf waters that the southern half has long held to the favorable mean of dry days, rain and warmth. Long coastal barriers afford further protection.

Even a cursory glance at forest distribution in Florida serves to throw into relief the belts and regions of change of first concern. The upper half of Florida is still favorable to the "long leaf pine" (*Pinus palustris*), and now undergoes marked variation in its winter temperatures. Facing the Atlantic, this forest sharply gives way to the "spruce pine," and not far below Vero the palmetto-cycad underbush begins. Along the southern-western coast, is the region of "pine islands and cypress straits," as Bowman says, "even more monotonous than the east coast." All the higher ground is invested by a *Pinus heterophylla* forest, with a nearly pure palmetto underbush, while the cycads also show a different facies. The *Zamia floridana* is rare in the open woods, although the *Z. pumila* grows more characteristically inside the mangrove fringes next the coast.

The Vero man thus occurs near the border of the "spruce pine" (*Pinus glabra*) forest, with its striking and unique underbush of cycads and bush palmetto (*Zamia floridana* and *Sabal serrulata*). The latter in places make up the underbush nearly in equal numbers. But that this striking forest facies earlier extended to the north of Vero is probable; while in any case Vero lies within a region locally characteristic for its old floral elements, and of generally soft climate since the Eocene.

Evidently the "spruce pine" country exemplifies a pronounced type of the so-called "asylum" or isolated and persisting habitat subjected throughout long periods of time to the minimum of environmental change. Especially the cats earlier tended to drift to the south; and there the man of Vero found them when he reached that soft climate and employed of developed arts admittedly recent. Seemingly too, the fossil plants and animals of Vero, after persisting beyond their geologically appointed time, were finally cut off by changes relatively slight.

G. R. Wieland

Yale University

SCIENTIFIC BOOKS

Fossil Plants. By A. C. Seward. Cambridge Biological Series 1917. Vol. III., pp. xviii + 656, 629 figs.

The present volume, the third of Seward's great work, Volume 1 having been published in 1898 and Volume 2 in 1910, is appropriately dedicated to the late Professor Zeiller, the dean of paleobotanists. It is to be followed by a fourth volume, which it is stated is already in press, and which will discuss the remaining gymnosperms—the great group of angiosperms, so abundant in the fossil record from the mid-Cretaceous to the present, apparently not coming within the category of fossil plants in the mind of a British botanist, which is quite in keeping with British tradition and practise.

Volume 3 opens with a very satisfactory chapter devoted to a discussion of existing cycads, largely an abstract of already published data. Then follow three chapters devoted to the Pteridospermæ. These are divided into three families—the Lyginopteridæ, Medulloseæ and Steloxyleæ, and are rather fully and very satisfactorily discussed.

The remaining structural forms that are probably more or less closely related to the foregoing pteridosperms are considered to represent the following seven families: Megaloxyleæ, Rhetinangieæ, Stenomyeleæ, Cyca-

doxyleæ, Calamopityeæ, Cladoxyleæ and Protopityeæ, and these are discussed in a separate chapter under the group term of Cycadofilices. These presumable pteridosperms, because of the dearth of conclusive evidence, are thus arbitrarily segregated. While caution is to be commended in dealing with fragmentary plant fossils it may be questioned whether judgment may not be suspended until it dies of inanition. It is also questionable how far it is desirable to introduce purely artificial groups, and if it be granted as desirable, it may be pertinent to ask what criteria are to decide such a question. That such a course does not make for clearness and that such questions rest after all upon personal equation rather than upon objective facts may be illustrated by Seward's reference of the genus *Steloxylon* to his Pteridospermæ and the scarcely to be distinguished genus *Cladoxylon* to his Cycadofilices. The fact that so many of the so-called families of the latter group are monotypic is convincing enough evidence that they illustrate chance discoveries and the imperfection of the geological record and that they have absolutely no other significance such as Scott has suggested.

Following the chapter devoted to Cycadofilices are two chapters dealing with the Cordaitales which are described under the three groups of Poroxyleæ, Cordaiteæ and Pityeæ. A succeeding chapter of 65 pages is devoted to Paleozoic gymnospermous seeds and the remainder of the book is taken up with a consideration of fossil Cycadophytes. These last chapters are, on the whole, a very satisfactory summary of the present state of our knowledge although the concluding chapter, devoted to the fronds, is much abbreviated and not especially noteworthy.

There can be no doubt of the usefulness of Seward's book, particularly in the case of mature students and professional morphologists. The author has a wide acquaintance with the literature, especially on the side of morphology and modern botany, and the book shows throughout the results of considerable original work and a large amount of reinvestigation of insufficiently described material of older workers. It may seem ungracious to criticize a noteworthy undertaking but it seems to the reviewer that throughout the three volumes already published there is a disregard of proportion and an unevenness of execution that seriously impair their value. It is impossible to discover the method of selection of matter to be included—unimportant and even doubtful forms are sometimes discussed, as under *Williamsonia*, among the seeds, or the frond genera of Cycadophytes, while more important material is not even mentioned. In a work spreading through four stout volumes one reasonably expects either completeness or a formulated method of selection. If the desire was to present in the main fossil plants based upon structural materials, why burden the pages with a very incomplete representation of other classes of plant remains.

The author assumes an oracular air that reminds one of Lowell's charming essay entitled "On a certain condescension in foreigners," and there is constantly displayed a readiness to pass judgment merely on the illustrations of other students' work, often in cases where most paleobotanists would be disposed to deny the author's competency, as for example in the case of the determination of American species referred to *Eremopteris*. There are also certain insular tendencies, as in the overemphasis of Carboniferous, Jurassic and Cretaceous horizons that have been studied in Britain, and the space devoted to the local history of important British specimens.

Professor Seward's position on the difficulty of founding well-marked botanical species on material preserved as impressions is well known and in the main sound. However, as has been pointed out recently by Halle, this does not justify the assumption that all fossils that are superficially similar belong to the same species regardless of geographical position or geological horizon. Such a method of treatment entirely obscures whatever real value such fossils may have for purposes of deduction concerning geographical distribution, the problems of paleogeography growing out of distribution, and the bearing of fossil plants upon stratigraphy.

As a contribution to morphological botany nothing approaching the present book from the paleontological side has ever been produced and I am not surprised that Scott[1] is enthusiastic about it. I would expect Professor Coulter to be equally enthusiastic. As a textbook of fossil plants intended for geological students as its subtitle indicates, or as an exposition of the geological history of fossil plants it is very inadequate, and I regard this as a serious defect since the great majority of students who will use the book, while they will gain a much wider morphological outlook, will scarcely learn that fossil plants have attributes other than anatomical, or if they do they will conclude that such attributes are worthless anyway. Nor will they gather the impression that fossil plants are found much anywhere except in the Carboniferous, Jurassic and Wealden.

The proofreading of volume 3 is not as good as in the preceding volumes and some of the illustrations are very poor; nor is the bibliography as complete as it might well have been made. A paper by White is credited to Knowlton, Vignier should be Viguier. Krammera (page 277 and elsewhere) should be Krannera. The statement on page 276 that there is no proof of Cordaites in the Arctic may be a statement of opinion—it is hardly a fact. The statement on page 276 that "it is by no means certain that Cordaites flourished before the Carboniferous" is also misleading. Apparently Seward wishes to restrict the Cordaitales in their earlier manifestations and extend them in their later manifestations as in the case of *Noeggerathiopsis* and similar remains. Surely *Callixylon Oweni* described by Elkins & Wieland from the Devonian of Indiana[2] is ample evidence for the presence of Cordaites in pre-Carboniferous rocks. It may be seriously doubted if the two types represented by *Cycadeoidea* and *Williamsonia* were not much more divergent than is indicated, or if the former were the Mesozoic lords of creation of the vegetable world that is assumed. Despite the similarities in the fructifications in these two lines, the reviewer would regard the former as a specialized sideline without issue and probably never more abundant or important than are cycads in the existing flora, while the latter constituted a more dominant and progressive line, more intimately connected with the Paleozoic pteridosperms and having points of contact with possibly the Ginkgoales or the Coniferophytes. The bulk of the frond genera were probably borne by plants of the *Williamsonia* rather than of the *Cycadeoidea* type. It may be noted that the American Cycadellas come from the Lower Cretaceous and not the Jurassic. The author is hardly justified in doubting the bisexual character of the so-called flowers of *Cycadeoidea Gibsoniana*, nor is it easy to follow him in his explanation of the corona of *Williamsonia gigas* as morphologically a whorl of connate stamens in a central terminal position.

When it is remembered that throughout all of the *Cycadeoidea* species already investigated the megasporophylls become more or less sterile distad and that in some species, as Wieland has demonstrated, these, together with the prolonged interseminal scales, are modified to form a mop-like tuft at the apex of the receptacle, and also having in mind the ears or wings of the microsporophylls that formed a canopy over the apex of the receptacle in *Cycadeoidea colossalis*, it is quite possible to explain Seward's figures 546 and 547 in a variety of ways without recourse to the improbable hypothesis that we have terminal microsporophylls. In fact, there is no evidence that the so-called microsporophylls of *Williamsonia gigas* described on page 435 belong to that species. Fig. 549 no doubt represents a synangia-bearing disk of a *Williamsonia*, but there is not the slightest evidence that it belonged to *Williamsonia gigas* or that it should be placed on the end of a *Williamsonia* carpellary receptacle. Similarly the sterile disks or infundibuliform organs have not been demonstrated to have been borne on the apex of the receptacle.

On page 89 some poorly preserved *Myeloxylon*

[1] Scott, D. H., *New Phytologist*, Vol. 16, Nos. 8, 9, 1917.

[2] Elkins, M. G., and Wieland, G. R., *Am. Jour. Sci.* (IV.), Vol. 38, pp. 65–78, 1914.

petioles are appealed to as evidence of the existence of *Medullosa* in North America. Of course fronds are not evidence so it may be reassuring to state that characteristic sections of petrified stem material of *Medullosa* are contained in the collections of the U. S. National Museum, so that it may now be considered proven that *Medullosa* foliage was, in life, borne on *Medullosa* stems in America as well as in Europe. It may be questioned (page 87) whether leaf form is more protean than either vascular anatomy or floral morphology. Apropos of Seward's remarks on the genus *Schützia* it may be noted that in a paper which has apparently been overlooked, Schuster[8] describes specimens of *Schützia anomala* in the Dresden Museum, labelled in Geinitz's handwriting, which show definitely that these objects were spore receptacles as had been surmised.

The forms known as *Microzania gibba* (page 504) and *Zamites bohemicus* (page 584) come from the Upper and not the Lower Cretaceous. It would be far better if the term Wealden were used to denote a peculiar environmental facies as shown in the lithology and not a chronological unit. There is no more reason for calling deposits in all parts of the world Wealden than there would be for calling the English Wealden deposits Potomac.

On page 278 the genus *Pelourdea* is proposed for the long-known *Yuccites vogesiacus* of Schimper & Mougeot because the author considers it undesirable to retain a designation suggesting false ideas with regard to affinity. No one now supposes that this is suggested and such a proposal is entirely unwarranted and can only be confusing instead of clarifying. Moreover it is flying in the face of all canons of nomenclature. A name of a genus is simply a name, and we use generic names for convenience chiefly, and not in a descriptive or phylogenetic sense. I imagine that fully 25 per cent. of the names in systematic botany and zoology are equally inappropriate for one reason or another but this does not afford any justification for attempting to replace them. There is surely a difference between retaining a degree of personal independence in the face of codes and the persistent refusal to recognize the fact that practises of this sort serve only to confuse the subject.

Cordaianthus Pitcairniæ figured on page 266 is merely a type of inflorescence and is scarcely entitled to a specific name. At *B* in the same figure (Fig. 480) there is figured from the Kidston collection, a specimen which is called *Cordaianthus Volkmanni*. The latter belongs to the type of inflorescence which Grand'Eury called the *gemmifer* group, to which this specimen does not belong, although it does belong to Grand'Eury's *baccifer* group, and should probably be identified as *Cordaianthus subvolkmanni*. The genus *Holcospermum* (page 361) is hardly an improvement on *Carpolithus*, and it would seem that if form genera for seeds are worth anything at all then *Holcospermum* should be referred to Zalessky's genus *Polygonocarpus*. This last genus is mentioned under *Polypterospermum* on page 323 where we are told that *Radiospermum* or *Polypterospermum ornatum* should probably be referred to it, while on page 358 we are told that this species affords another example of *Polypterocarpus* as this generic name is employed by the author. Nowhere is the genus *Polygonocarpus* discussed (it is not even in the index) although it is of some importance, and, if one may judge from Scott's figures of *Trigonocarpus Parkinsoni*, is the proper name for his specimens of the latter. If the reader will turn to Seward's Fig. 426 *C* he will see that the sclerotesta of Scott's *Trigonocarpus Parkinsoni* is of exactly the type of *Polygonocarpus*. Now if this figure be compared with Fig. 425 on the opposite page, also called *Trigonocarpus Parkinsoni*, it must be apparent that the two do not represent the same seed or the many angles of the former would show through the partially preserved sarcotesta of the latter, which is not the case, nor is it desirable on general principles to refer structural material to form genera based upon casts.

[8] Schuster, J., "Über die Fruktifikation von *Schuetzia anomala*," *Sitz. k. Akad. Wiss. Wien*, Band 120, Heft 8, Ab. 1, pp. 1125–1134, Pls. 1, 2, 1911.

As an instance typical of that unevenness of treatment previously mentioned the genus *Samaropsis* may be examined with some slight detail. In Fig. 502 *A* on page 350 are shown three figures copied from Dawson of *Samaropsis fluitans*. This species is apparently selected for discussion and illustration since this name appears in many lists of Carboniferous fossils from various localities. Dawson's figures are notoriously unreliable, as is very well known on this side of the Atlantic, and his types of *Samaropsis fluitans* scarcely deserve to be taken up as the types of anything. Now if we turn to *Samaropsis fluitans* as identified by Weiss we find that it represents an altogether different object. Similarly Kidston's and Zeiller's *Samaropsis fluitans*, while they are identical with one another, can hardly be considered as identical with either Dawson's or Weiss's objects so named and Grand'Eury's *Samaropsis fluitans* is a still different object. Turning to the second species shown in this figure, namely *Samaropsis emarginatum* of Goeppert & Berger, we find that the type figures are absolutely unrecognizable. We find that Geinitz referred two totally different forms to this species, Hoffman & Ryba's determination of it is questionable, Feistmantel's forms of this name are still different, and Kidston's figures of 1902, 1908 and the present work can scarcely be regarded in any single instance as representing any of the previous determinations. If we turn now to *C* and *D* of this same figure, supposed to represent *Cordaicarpus Cordai* of Geinitz we find that Geinitz figured a variety of things under this name, but he expressly states in his text that these seeds are 2 cm. in diameter and sometimes twice that size and tumid. When we turn to Zeiller's, Kidston's or Vernon's figures called by this name we find a tiny, often flat, form, totally unlike anything that Geinitz figured. It may also be suggested that *E* of this figure is upside down and that instead of having a *Samaropsis bicaudata* we have a *Samaropsis bicornuta*, for which there are analogies in other species of *Samaropsis*.

These instances may be taken to illustrate my criticism that unsatisfactory forms were selected for figuring in the present work without any digestion of the subject simply because the names occur frequently in the literature, a method of procedure which not only entirely obscures any chronologic value that these objects might have, but crowds out figures or discussion of really good material. The case may be stated something as follows: The poorer the type material of a species the more readily will other things be confused with it and so in the course of time it is always the least recognizable and the poorest types that become credited with the greatest range, both geological and geographical.

This sort of criticism might be legitimately applied to many other items in the present volume. These are almost always subjects outside of Professor Seward's own specialty, and subjects in which I fancy he is not greatly interested, and while they do not detract from the value or accuracy of that part of the work where the author is on familiar ground, an author should not pose as an authority on phases of work in which he shows no apparent interest or willingness to give the labor necessary to the mastery of the literature, so much of which it is admitted is of minor value.

For this very reason and the further reason previously mentioned of Seward's attitude regarding what constitutes a fossil species, it may be considered very fortunate that the author has been unable as yet to carry out his intention of discussing the geographical and geological distribution of fossil plants.

Edward W. Berry
The Johns Hopkins University,
Baltimore, Md.

SPECIAL ARTICLES

THE GLASS SANDS OF PENNSYLVANIA

At present in the manufacture of glass, nearly pure quartz sands are used almost exclusively as the source of the silica which is the major constituent of all the common varieties of this useful substance. An ideal glass sand would be one made up entirely of grains of the mineral quartz. Sands containing 100 per cent. silica, however, are not found in nature, although some very nearly approach

this composition. When a complete chemical analysis of a glass sand is made, minute amounts of alumina, ferric and ferrous oxides, magnesia, lime, titanium oxide, traces of the alkalies, and varying amounts of water are usually found to be present. Some of these constituents are harmless, while others have a very deleterious effect upon the glass.

Alumina imparts both desirable and undesirable properties to the resulting glass. It reduces the tendency of the glass to devitrify or crystallize. It decreases the solubility of the glass in water, weak acids, and other reagents, which is very desirable in the case of bottles and chemical glassware. It increases the surface tension of the glass when chilled rapidly, which is beneficial in molding, as the glass will not take on the minor imperfections of the mold, while, on the other hand, it will still be sufficiently viscous to assume the general shape of the mold. It reduces the coefficient of expansion of the glass and increases its tenacity, a feature also desirable in the case of bottles and chemical glassware. Alumina in glass facilitates annealing. It also makes the glass somewhat harder and a little more brilliant. An undesirable feature is that alumina tends to decrease the fusibility of the glass and increases its viscosity. It should, therefore, not be present in amounts exceeding 3 per cent. Also glass cullet containing alumina does not mix well with other glass and, therefore, tends to produce cords or striæ when used. The light blue tint noticeable in certain glasses made from salt cake is thought by some observers to be due to alumina in the form of a compound analogous to ultramarine blue. Alumina may occur in glass sands in the form of kaolinite, mica, feldspar, or hornblende. If it is present as kaolinite or mica it may be largely removed by washing.

Iron in the form of either ferric or ferrous oxides is the most detrimental impurity found in glass sands on account of its coloring effect upon the glass. Ferrous iron imparts a bluish green tint upon glass, while ferric iron produces a yellow tint, which is not nearly so noticeable. Since most glass is made under reducing conditions, the green color is the one usually developed. Where the amount of iron present is small, this coloring effect can be in part overcome by the use of manganese dioxide, nickel oxide or selenium. For the best grades of optical glass the percentage of ferric oxide present in the sand should not exceed .002 per cent. For the better grades of lead flint used in the manufacture of cut glassware it should not exceed .02 per cent. In the case of plate glass to be used for mirrors the ferric oxide should not be over .1 per cent., while in the case of plate glass to be used by transmitted light it may run up to .2 per cent. For window glass the amount may be as high as .5 per cent., while in the case of ordinary green and brown bottles sands containing from .5 to as high as 7.0 per cent. ferric oxide is used. Iron may be present in the sand in the form of limonite, hematite, magnetite, ilmenite, biotite, hornblende, or chlorite. A little may also be introduced as metallic iron from the machinery used in crushing the sandstone to sand. If it is present as limonite or hematite closely associated with the kaolinite or clay, it may be in large part removed by washing. If, on the other hand, the limonite or hematite adheres closely to the quartz grains washing will be of no avail. The other minerals mentioned can not be readily removed by washing.

The small amounts of magnesia and lime occasionally present in glass sands have no detrimental effect upon the glass. All the common varieties such as plate, window, and bottle glass contain lime as an essential constituent. Magnesia is much more apt to be introduced into the glass batch through the limestone used than through the sand. The composition of this material, therefore, must be watched with respect to this constituent. Alkalies, likewise, enter into the composition of glass and the minute traces occasionally present in the sand, therefore, are not harmful. Titanium oxide never occurs in sufficient amounts to have any detrimental effects upon the glass. It usually occurs in the sand as minute hairlike inclusions of rutile in the quartz grains, themselves. In the case of the better grades of glass such as optical, lead

flint, and plate, the sand is always carefully dried before being used.

In size for ordinary purposes of glass manufacture practically all of the sand grains should pass through a 30-mesh sieve, or in other words have a diameter less than .64 millimeters. The majority of the grains should be retained on a 120-mesh screen, or be over .136 millimeters in diameter. For optical glass, all of the sand should pass through a 48-mesh sieve. The shape of the grains has little to do with the relative values of the sand, although perhaps an angular sand is a little more desirable than one in which all of the grains are well rounded, other factors being equal.

In 1915, Pennsylvania produced 455,112 tons of glass sand. This represents about one fourth of the total production of glass sand in the United States. Pennsylvania holds this important rank as a producer of glass sand for two reasons: first there are found within her borders an abundant supply of nearly pure quartz sandstones that yield when crushed an excellent grade of sand, and secondly the center of the glass industry of the United States is located in western Pennsylvania so that there is a great demand for such sand. Nearly all of the glass sand at present produced in Pennsylvania comes from two formations, the Oriskany of the Devonian and the Pottsville of the lower Pennsylvanian. Of these the Oriskany is by far the more important.

The Oriskany formation occupies the belt of Appalachian folding which crosses Central Pennsylvania and which reaches a maximum width of nearly 56 miles. It varies greatly in this area both in thickness and in character. In Huntingdon and Mifflin counties a pure quartz sandstone phase, which has a thickness of from 60 to 200 feet, is particularly well developed. In its unaltered state it is a hard bluish-gray quartzite made up of interlocking grains of quartz in which silica in parallel orientation with the original grains is the bond. Under favorable conditions of weathering this has become disintegrated to a friable sandstone, or in some places even to a loose sand. These are the portions that are used for glass sand. For this purpose the sandstone must be sufficiently friable so that small pieces may be broken up between the fingers into loose sand. In preparing it for the market the rock is passed through a jaw crusher and chaser mill or wet grinding pan to disintegrate it into loose sand. It is then screened, passed through a screw conveyor type of washer, the excess water is allowed to drain off, and the sand is dried in a steam or direct heat dryer. After a final screening it is ready for the market. Much of the best grade of glass sand produced in the United States comes from this district.

The Pottsville formation of western Pennsylvania is divided into five members as follows, commencing at the top: the Homewood sandstone, the Mercer shale, the Connoquenessing sandstone, the Sharon shale, and the Sharon or Olean conglomerate. Of these portions of the Homewood and the Connoquenessing sandstones are at times sufficiently pure quartz sandstones to be available for glass sand. The sand derived from them, however, is never as pure as that from the Oriskany of central Pennsylvania and is, therefore, used only in the manufacture of the cheaper grades of glass such as bottle and window glass. A little is also used in the plate-glass industry. The method of treatment is usually the same as that used on the Oriskany sandstone in central Pennsylvania, except that drying is usually dispensed with. Sometimes, however, the rock is simply crushed dry and screened, washing not being resorted to.

CHAS. R. FETTKE

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

Friday, August 2, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE NEWER DEMANDS ON PHYSICS AND PHYSICS TEACHERS DUE TO THE WAR[1]

At this time when the daily press all over the world is filled with statements and exciting accounts, proving beyond all doubt that the present war is a war of science, we, who pose as champions of so basic a branch of science as physics, would be guilty of gross carelessness should we not in some way take advantage of this unprecedented world-wide advertising. As expressed recently by the president of The American Institute of Electrical Engineers, "a flood of scientific and technical accomplishment has swept over the face of the earth."[1a] and it is just such a description of our world war that the physicit must consider if he is to aid in bringing about the end—or assist in its indefinite continuation, if need be—or if as a teacher he is to prepare his pupils for the new wartime and peaceful duties sure to fall to the lot of every citizen in the newer civilization now passing through the agonies of its birth.

What are some of the points where immediate attack by physics teachers may be expected to result in compensatory results to the nation? What are the demands on these apostles and on their science? If any, what are the opportunities for the promulgation of this science, accompanying, or growing out of this opportunity for service?

There are two general aspects to the whole inquiry. One is that of the imme-

[1] Read before the Ohio Academy of Science, Columbus meeting, May 31, 1918.

[1a] *Electrical World*, July 7, 1917, p. 5.

diate service to the nation that the information or ability of the physicist may afford. Of this I need say nothing. The other, and one which is not clearly separable from the first, is the question of our opportunity to take advantage of the world's awakening to the realization of the value of fundamental science, and establish as never before an interest in that broad domain closely analyzed only in the study of physics. Though the utilitarian motive may always be one of the chief recruiting agencies for any fundamental science, there is now every reason to believe that in the immediate future it will be glorified by an accompanying inspiration—for this world-wide "flood of scientific and technical accomplishment" which is now identified with the war, and which will attain to even loftier heights in ending the war—this upheaval is accompanied by one of no less importance for the future—the sudden unrest and dissatisfaction of the average individual with his own scientific appreciation. To keep pace with events even now makes an effort toward progress along this line imperative. Survival hereafter may be synonymous with successful competition in a new world where scientific method based upon ever-increasing scientific information is the dominating factor in existence. Hence it is that we, simple teachers of physics, have now an opportunity and a duty, probably unique.

Even against the advice of the President and other government authorities, our students, though below draft age, are rushing into the war because there have come to them ever louder the echoes of a larger life now centered in the great struggle, which have brought with them to the youthful mind the sudden realization of the fact that his academic world is not the most actual one, that he is not learning in the most direct manner of the things that count, and he is truly justified in answering the call to enter that world where his interest may be focused on things felt to be real.

What can be done that will help him when he goes, or to strengthen him in the most efficient manner while he stays? Those who leave must go with all possible preparation; those who remain behind must be well armed for the equally important struggle here—and the beginning steps for the teacher, for example, the teacher of physics, are clearly indicated by the sudden development of a host of new questions of interest in themselves, and which may serve to entice the beginner through uninviting portals into a new storehouse of endless benefits for him and all with whom he may come in contact

Let us consider some of the more common questions specifically, in approximately the general order in which we have been accustomed to classify their kind.

To begin with, we may take aviation. Here we have ample material for the discussion of such good physics that even the most conservative text-book-repeating pedagogue can not object. To the student it affords a most impressive illustration of the relation of action to reaction, also of the omnipresence of friction, and at the same time of its indispensable utility—and again, of the universality of gravitational attraction. There is also the question of the non-ricocheting shell[2] that will dive and not glance from the surface of the water when directed toward a more-or-less submerged submarine. Such devices can not be explained to the ordinary class completely, but the nature of the solution of the problem can be indicated with sufficient detail to increase rather than chill the student's interest. He asks about the various types of unsinkable ships, and even

[2] *Scientific American*, February 9, 1918, p. 125.

though he may not now know the actual details of the construction of such a craft, he soon sees the general requirements to be satisfied. Archimedes's principle acquires a new interest. The laws of fluid pressure become more than text-book formulations of rare phenomena. His knowledge of the fact that water is practically incompressible enables him to criticize constructively such a story as told by the preacher who pictured to his horrified audience the wrecked *Lusitania* coursing the ocean ways at some far-down level below which no ship can ever sink. He sees new light when it dawns on him that even "the whys and why-nots of deep sea diving"[3] come well within the field of discussion of an ordinary course in physics. Then again, the nation-wide interest in the conservation of ammonia for the manufacture of explosives lends new color to the whole subjects of heat and of gas phenomena, from the simple laws of Boyle, of thermal expansion, of heat exchanges, to the applied side of refrigeration. Perhaps for the first time he sees the reason for having a kinetic theory of gases.

Next, perhaps, may come the field of sound, commonly considered as one of the minor branches of physics, a judgment somewhat justified, for in the more elementary texts such as used in the high schools, this subject is allowed only from six to nine per cent. of the space in the book. And why? Surely not because its phenomena are fewer than those of the other phases of our science, not because they are of less importance, but rather, let us say, because they are less understood. After the United States entered the war and a census of our scientific abilities was taken, American physicists had to admit that after all no one knew very much about sound. The great sources of information were the works of Helmholtz and Rayleigh, treasure stores, to be sure, but limited in their applicability to practical problems, and containing little that could be recast into any form digestible by either practical workers or students. And then came real problems, thick and fast. Methods were sorely needed for locating the enemy in the sea and in the air. In all of these directions some success has been attained, but until details are made public the physics teacher will have to supply what he can by way of suggesting the probable solutions of the problems. He knows something of the possibilities, something of the conditions that must be satisfied, and he is, or at least should be, free from the danger of the illogical reasoning of which others may be guilty. For example, he can assist his pupils in understanding how it is that successful methods can be devised for insulating a whole region against air-sounds and earth-sounds.[4] Doppler's principle finds a new illustration in the phenomena produced by a near-by projectile.[5] Then there are those other questions, not so easily explained, such as those about the causes of distinct sound areas separated by a zone of silence which may be several miles in width, although the disturbance has originated at a single source, as in the case of some of the explosions in East London.[6] Such questions surely make new demands on the investigator and teacher, but at the same time they afford unequalled opportunities for enlisting the interests of many to whom the subject has been wholly foreign.

For the first time artificially produced sounds are observed to have traveled as

[3] *Scientific American*, January 12, 1918, p. 60.

[4] *Elekt. Zeits.*, 38, pp. 410–441. Also *Science Abstracts*, *A*, No. 180, February, 1918.

[5] *Science Abstracts*, *A*, No. 528, 1917.

[6] *Science Abstracts A*, No. 1295, 1917. *Phys. Zeit.*, 18, pp. 501–504. *Science Abstracts*, *A*, No. 183, February, 1918.

much as two or three hundred kilometers[7]—how, we can not say, but probably in no manner different from that in which lesser disturbances are propagated. And this is typical of a fact the teacher should not overlook. Scientific progress is the discovery of more truth, rather than the contradiction of laws already clearly established.

No one who has had the pleasure of seeing some of the beautiful slides, such as those from photographs by Professor Foley, showing sound waves in all stages of development—birth, growth, reflection, refraction—can question their interest, or their instructiveness. And yet, what are the emotions that stir one as he reads of the visible sound waves described by several observers after moments of extra violent cannonading along the battle line.[8] Distinct bands were actually seen moving across the clouds with the known velocity of sound, or again, equally distinct against a clear sky. Such points of interest should escape no teacher of physics, for nothing can be more legitimate than enlisting the pupil's interest with illustrations of this kind.

Other problems in other fields are fully as numerous and as fascinating as those we have noted, but we will have to content ourselves with mere reference to some of them. What of the application of optical principles? At home we have protective lighting[9] based upon an ever-improving appreciation of the correct principles of illuminating engineering. Then again, American manufacturers have struggled heroically and with incomplete success to produce good optical glass. The student wants to know the reason for this endeavor—the reason for the failure—the necessity for such glass anyway. And who is to enlighten him if not the physics teacher. When he seeks to learn something about the submarine camera, he comes upon the stabilizing gyroscope.[10] He also finds that the search lamp is an optical instrument of high design, and that the manufacture and operation of the portable gasoline-motor-electric-generator search-lamp outfits embraces a wide field of activity and many physical principles.[11]

Even the teacher must be alert to keep up with only such phases of physical development due to the war as are published. There are new methods for testing mirrors for signalling purposes and special apparatus for measuring magnifying powers and the angle between the axes of binoculars. The Michelson interferometer finds use in finishing prisms, lenses and combinations. There are weathering tests for glass, new tests for parallax in the telescopic sights for rifles, new methods for determining the illumination and field of view of field glasses, special parallelism tests, micrometers for measuring prism angles before polishing, and new surface testing methods.[12] The refractometry and identification of glass requires special equipment and training.[13] Range finders have multiplied, even the prismatic binocular having joined the list by the simple addition of a calibrated disk by means of which the distance to an object of known dimensions can be determined.[14] Unfortunately all of these

[7] *Science Abstracts A*, No. 657, 1917. *Science Abstracts, A*, No. 658, 1917.

[8] *L'Astronomie*, July, 1917. *Scientific American*, November 10, 1917, p. 343.

[9] *Electrical World*, May 18, 1918, p. 1049.

[10] *Scientific American*, May 19, 1917, p. 483. *Trans. Illum. Eng. Soc.*, XII., 8, November 20, 1917, p. 396.

[11] *Trans. Illum. Eng. Soc.*, XII., 8, November 20, 1917, p. 357. *Elect. World*, December 9, 1916, p. 1169.

[12] *Science Abstracts, A*, 379, 1917.

[13] *Scientific American Supp.*, No. 2178, September 29, 1917, p. 198.

[14] *Scientific American*, January 12, 1918, p. 60.

latter devices are far too scarce. The industry concerned in their manufacture as well as the youth who may be called upon to use them, must be encouraged to the fullest possible extent, not only to win in the present war, but for the sake of the future. The recent condition has been aptly described by Professor Southall. Last December he pointed out that the British navy was almost without range finders at the opening of the war—that almost the entire optical industry had to be built up both in France and in England since that time. But what is of especial interest to the physics teacher is his statement that, "if the optical industries are to be encouraged and developed among us, not only now but in the years to come after the war, there will be an increasing need of trained and experienced men with more or less extensive acquaintance with the whole range of optics, both theoretical and applied."[15] Here is a demand and also an opportunity. Only recently has there been organized anything like a comprehensive series of courses in the various branches of geometrical and physical optics. For the first time an American university now offers complete courses in the "Theory of Modern Optical Instruments, Lens Design and Lens Testing, Manufacture of Optical Glass, Refractometry, Polarimetry, Physiological Optics, Photometry, Spectrophotometry, Colorimetry, Optometry, etc."[16] There is a new interest in the optics of vision due to the physical examination for military service, and at the same time we have corrective surgery of the eye, again based on physical principles.[17]

But to hasten on. Smoke screens on the sea had no sooner begun to shut out ordinary vision than there came the suggestion that the use of infra-red and ultra-violet lenses would make photography perfectly possible.[18] Surely this involves physical principles of interest to the student because of their increasing utility, if for no other reason.

New methods of photometry have had to be developed because of the growing military use of fluorescent and phosphorescent compounds.[19] Here the Purkinje effect again appears. Then again, the selenium cell has received such study that its sensitiveness has been increased a thousand fold.[20] Can the student escape the charming influence of such ideas as these developments afford? Can the teacher do less than encourage this interest to the fullest extent possible?

The war is responsible to a great extent for the fact that more attention was paid to illuminating engineering than to any other branch in the leading articles in the most important technical periodicals in 1917.[21] Here is a great field of applied physics just opening up. Its demands on the present-day teachers are evident. Its opportunities need not be discussed.

And so we could go on through the various divisions of physics. Under electricity, we meet our old acquaintance, the Hughes induction balance, now equally serviceable for locating shells buried in the earth and fragments embedded in the muscles of the human body. Coal shortage has pushed hydro-electric development. Food scarcity has aroused new interest in the electro-culture of crops. Magnetic surveys similar to

15 *Scientific American*, December 15, 1917, p. 455.

16 *Scientific American*, December 15, 1917, p. 455.

17 *Scientific American*, January 12, 1918, p. 53.

18 *Scientific American*, September 22, 1917, p. 207.

19 *Trans. Illum. Eng. Soc.*, November 20, 1917, p. 394. *Illum. Eng.* (Lond.), March 1917, p. 76. *Rep. Nat. Phys. Lab.*, 1915–16, p. 33.

20 *Trans. Illum. Eng. Soc.*, XII., 8, November 20, 1917, p. 395.

21 *Trans. Illum. Eng. Soc.*, XII., 8, November 20, 1917, p. 117.

those made for land and sea are now needed for the air.[22] Wireless telegraphy and telephony have advanced by leaps and bounds, and simple inductive telephony has reached a high degree of development in the very front lines of the opposing armies.[23] Electrical schools have opened up for the training of war-made cripples.[24] The radiodynamics of torpedo and boat control offers a field for study almost new. The use of the X-rays requires constructors, operators and doctors who have acquired the requisite fundamental principles in good courses in physics. Electrochemical processes in general are becoming American for the first time, and every citizen is continually being reminded in one way or another of the fact that the war is one of science, and that the reconstruction must likewise be one based on a knowledge of natural laws.

There is still another phase of our new development which makes a definite demand on the physics teacher. It is the part that women are to take in the life of the nation in the years to come. Whatever may be one's idea of equal suffrage, he must recognize the fact that a large portion of the burden of the world war is being borne by women. They are entering the industries; they are becoming electricians, machinists, chemists, in fact everything that man has wished to be solely. And with this awakening will undoubtedly come wide interest in the sciences fundamental to industrial activity. New economies have required more detailed explanations of the scientific methods of obtaining them. Household physics, though a comparatively recent term, has now for the first time come to have a real meaning. Surely the present war, however unpleasant it may be otherwise, will serve above all other things to hasten the happy era of better ideals, when the joys and burdens of the world will be more equally shared by its men and its women. Hence, the instruction of the girl as well as of the boy makes new demands on the teacher, and affords him widening opportunities for developing his subject as an integral part of the school curriculum, and thereby better himself by bettering every one else.

To enumerate additional problems brought to the physicist as a result of the war would be useless, but with the necessary increase in vocational education[25] will come the necessity for a more practical type of physics as presented to the elementary class. This suggestion is not meant in any way to disparage the more advanced type of research work, for it will be in greater demand than ever before, but, as always, the teacher must be the interpreter who shall spread abroad truths and thus justify the effort made in their discovery.

You well know that to include in such an attempt as the present one a comprehensive statement of such advances in physics as those which we are hoping may aid in winning the war, is futile. We do know, however, that advances are being made. We know something of the results. Those of us who are fortunate enough to have some knowledge of the details must remain silent because of military necessity. As recently expressed,

> Whatever startling developments have taken place during the year of 1917 are hidden behind the veil of the censor, and it remains for us to wait for the end of the war before a complete review can be undertaken.[26]

That the effect on physical research resulting from the present governmental co-

[22] *Scientific American*, April 20, 1918, p. 355.

[23] *Scientific American*, April 6, 1918, p. 305.

[24] *Elec. World*, November 17, 1917, p. 955.

[25] *Scientific American Supp.*, No. 2201, March 9, 1918, p. 149.

[26] *Scientific American*, January 5, 1918, p. 7.

operation will be inestimable, can not be questioned. The great British National Physical Laboratory, which is the equivalent of our own Bureau of Standards, has been taken over from the Royal Society for government work alone.[27] In our own country among numerous organizations may be mentioned the expanding Engineering Council, which now proposes an affiliation with all of the national engineering bodies and technical societies in the United States, thus bringing to physics and allied branches applications of unprecedented scope.[28] Our Council of National Defense, together with the Bureau of Education and the States Relations Service of the Department of Agriculture have considered the mistakes of the Allies and have emphasized the fact that the people now receiving any scientific training will have special advantages after the war. As Dr. Claxton, Commissioner of Education, has said,

> When the war is over, whether within a few months or after many years, there will be demands upon this country for men and women of scientific knowledge, technical skill and general culture as have never before come to any country.[29]

We must supply men and women familiar with fundamental science not only for our own development but to replace the hordes from European countries now going down on the fields of battle.

Again, President Wilson has asked that the National Research Council be perpetuated "to stimulate research in the mathematical, physical and biological sciences."[30] An Inventions Section as an agency within the General Staff of the War Department has been organized, and it is not without great import to the whole field of physics teaching that the Science and Research division is headed by Professor Millikan.

Still another probable development, that can not but bring joy to the heart of every physicist, is the more or less universal adoption of the metric system with the readjustment succeeding the war. England has already admitted that Germany has gained in industrial efficiency by the use of this system.[31]

> So many hundreds of young Englishmen have gone to somewhere in France that Englishmen have seen a great light in the simple workings of the decimal and metric systems. They are urging the abolition of the needless, brain-wasting multiplication of units at home.[32]

To date twenty-eight of the greatest public bodies in the United Kingdom have advocated the adoption of decimal systems of coinage, weights and measures. It can be no different in this country. We are now manufacturing some of our munitions of war to metric measurements, and surely this is a movement in which physics teachers should be the leaders. Knowing its value, they have advocated it in a half-hearted sort of a way for many years, but now, unbidden, comes a demand and an opportunity. No single development could go further to establish in the mind of the public the idea that physics is a science of practical value—that its ways are the ways of efficiency. And hand in hand with this movement comes the proposal from Dr. Klotz for universal scientific symbols.[33]

We have already gone further than was necessary to draw the conclusion of the whole argument. What has been said of physics is applicable in many ways to other branches of science. But the tacit assumption throughout has been that physics is one of the most if not the most basic of sciences. This may be a doctrine not universally accepted, but we who advocate it

[27] *Scientific American*, October 20, 1917, p. 283.

[28] *Scientific American*, April 20, 1918, p. 355.

[29] *Scientific American*, September 1, 1917, p. 153.

[30] SCIENCE, May 24, 1918, p. 511.

[31] *Scientific American Supp.*, No. 2175, September 8, 1917, p. 149.

[32] *Elec. World*, July 7, 1917, p. 3.

[33] *Scientific American*, December 8, 1917, p. 435.

on the basis of something more than a superficial knowledge of its content, can do so with all sincerity. It is legitimate that we should struggle to make it as popular a science as may be without discarding its essentially rigorous methods, for, as Dr. Nutting has said, the typical product of slack methods is a slacker.[34] But difficulties will only serve to heighten its estimated value, once it becomes generally known that physics is good for something. In meeting the demand for such evidence, the physics teacher will find the greatest opportunity for his own development and that of his beloved science.

E. H. JOHNSON

THE IRWIN EXPEDITION OF INDIANA UNIVERSITY TO PERU AND BOLIVIA

IN 1909 I summarized the knowledge of the distribution of South American fresh-water fishes in general. I dealt with the origin of the Pacific slope fish fauna in part in the following words:[1]

There are four distinct faunas on the Pacific slope of America between Cape Horn and the Tropic of Cancer. One of these is of common origin with that on the Atlantic slope, one is autochthonus and the other two are derivative from the Atlantic slope faunas opposed to them.

1. The fauna of southern Chili is essentially like that of Patagonia, and inasmuch as it is largely made up of marine forms entering fresh water, and fresh-water forms entering the ocean, it seems very probable that the species migrated from river to river along the coast from Patagonia to Chili or from Chili to Patagonia.

2. At the other extreme in the Rio Mezquital of the Transition Region and the Yaqui just to the north of it there is a fauna essentially like that of the Rio Grande east of them. As Meek has pointed out, the Yaqui and Mezquital have captured tributaries of the Rio Grande togther with the fishes in them, and the migration of Atlantic slope northern forms to the Pacific slope has been a passive one.

[34] *Scientific Monthly*, May, 1918, p. 406.

[1] Reports of the Princeton University Expeditions to Patagonia, III., 1909, p. 352.

Thus, types which in America north of Mexico have not succeeded in reaching the Pacific slope, have, within the Tropics, crossed the divide. . . .

3. The third fauna is the Mexican of the Rio de Santiago. This is undoubtedly the relict of an old fauna reenforced by a few immigrants from the north. It is here not a question of the origin of the fauna from an eastern one, but of an autochthonus development that has, on its part, contributed elements to the surrounding rivers. It passively contributed to the Atlantic slope fauna by having one of its small rivers captured by the Rio Panuco.

4. Of more particular interest is the origin of the fauna of western Peru and Ecuador and that of western Central America. Not enough is known of the fauna of the western part of Central America to attempt an explanation of its origin.

Concerning the Andean fauna I said in part, page 305:

The Andean region includes the high Andes on both slopes from Venezuela and Colombia to Chili.

It is poor in species at any given point, but some of the genera have a large number of local adaptations or species. This region is distinctly marked off into three provinces.

1. The Northern includes the highlands of northern Peru, Ecuador, Colombia and Venezuela. This is the richest in species and distinguished by the genera *Arges*, *Cyclopium*, *Prenadilla* and the high development of *Chætostomus*. Its fauna is largely an ancient derivative from the lowland freshwater fauna of Archiguiana.

2. The Titicacan, including the basin of Titicaca and neighboring streams, and possibly the landlocked basins of Bolivia, concerning which nothing is known, is distinguished by the genus *Orestias* and the absence of the genera distinguishing the northern province. Its fauna is largely an ancient derivative from the ocean.

3. The Southern is the poorest in species, characterized by the absence of everything but a few species of *Pygidium*, a genus which extends the entire length of the Andean region.

Further, p. 373, I said:

The points of strategic importance for ichthyic chorology in South America are, therefore, western Colombia and Panama, Guayaquil and Peru to the Amazon, across the Andes. . . .

Most of my time since the publication of the monograph quoted, in fact, since its preparation several years earlier, has been de-

voted to working out the details of a plan then made. I have had the cooperation of various institutions and individuals.

As part of this scheme I urged in Science, N. S., Vol. XXII., No. 549, pp. 553–556, the exploration of Panama before the canal should be completed. This work was well done by the late S. E. Meek and S. F. Hildebrand, under the auspices of the Field Museum and the Smithsonian Institution.

To examine conditions in Colombia I traveled in 1913 from Cartagena up the Magdalena to Girardot, thence to Bogotá in the eastern Cordilleras, thence across the Magdalena valley to Ibagué, across the central Andes to Cartago, up the Cauca valley to Cali, and across the western Andes to Buenaventura on the Pacific, thence up the Pacific slope stream San Juan, across the divide and down the Atlantic slope rivers, Quito and Atrato, to the starting point. My assistant during this trip, Mr. Manuel Gonzales, later visited the Atlantic slopes of the easternmost Andes between Bogotá and Barrigona, and Hermano Apolinar Maria, the efficient director of the Instituto de la Salle of Bogotá, had collections made for me in the Llanos east of Bogotá.

Mr. Hugh McK. Landon and Mr. Carl G. Fisher later enabled Mr. Arthur Henn, now in medical service with the American Expeditionary Forces, and Mr. Charles Wilson, also now in medical service, to explore the Patia and Atrato San Juan Basins of western Colombia, and still later Mr. Henn was enabled by Mr. Landon and Indiana University to explore the western slope of Ecuador, especially the Guayaquil basin.

Various attempts to secure the means to carry the work southward have failed until this spring, when the American Association for the Advancement of Science made me an appropriation of five hundred dollars, the Indiana University made a similar appropriation, and Mr. William G. Irwin, of Columbus, Indiana, sent the university a check to cover the larger part of the estimated expenses of the Peruvian part of the field work. The University of Illinois is providing the expenses of an assistant, Mr. William Ray Allen, who is to devote his time largely to parasites, and Miss Adele Rosa Eigenmann, a medical student in Indiana University, is to go as a volunteer assistant. Submarines being willing, we are to sail June 21 and the expedition is to be known as the Irwin Expedition.

As far as field work may be planned in advance, it is the intention to cross from the Pacific to the Amazon basin in at least three points in Peru:

First, Pacasmayo over Cajamarca to Balzas on the Marañon. The fishes of Pacasmayo are known in part at least through collections made by Osgood, of the Field Museum. Nothing is known of the fauna of the Cajamarca valley and very little of that of the upper Marañon.

Second, Callao over Oroyo, Cerro de Pasco to Huanuco. An attempt will be made to secure the faunas of the Rimac, of the High Andean Lake Hunin, and of the head waters of the Huallaga.

Third, Mollendo, Arequipa, Puno, Cuzco and Rio Urubamba. Attempts will be made to get as complete a representation as possible of the fauna of the Andean Lakes Titicaca and Poopo, and of the Rio Urubamba of the Ucayale basin.

Fourth, etc., some work will be done in Bolivia and Chili, but this will depend largely upon whether additional sums become available.

The expedition as definitely planned ought to give us as fair a notion of the Pacific slope fauna from the desert of northern Chili to Ecuador as we have of the Pacific slope of Ecuador, Colombia and southern Panama, as well as of the fauna immediately east of the crest of the Andes in Peru.

I am indebted to the president and trustees of Indiana University, who have made it my duty to devote myself to the work as outlined for the time needed to complete it.

Carl H. Eigenmann

SCIENTIFIC EVENTS

SCHOOL FOR OPTICAL MUNITION WORKERS

The War Industries Board authorizes the announcement that some of the fundamental

items required by the army and navy in war times are technical in nature and would ordinarily not be thought of by the casual observer. Such an item is optical glass, which is used in telescopes and instruments that serve in the direction and control of firing large and small guns and in engineering and surveying operations. The artilleryman without fire-control instruments can accomplish little; the submarine without its periscope is of small value; the airplane without a camera can make no maps of the enemy's country. Therefore, optical glass is very essential in military instruments of different types.

The optical glass problem in this country has been solved and there is now available manufacturing capacity for optical glass sufficient to supply the Army and Navy; but the skilled labor necessary to work up this glass into lenses and prisms, and to assemble these into finished instruments is not adequate. This situation is so serious that unless steps are taken to provide this labor the soldiers and sailors will be only partially equipped with necessary fire-control instruments.

To meet this situation the Ordnance Department of the Army is establishing in Rochester, N. Y., a training school for operatives on precision optics. The school is to be located at the Mechanics Institute, in Rochester, and the large optical manufacturing firms in Rochester are providing instructors and aiding in the installation of the necessary grinding, polishing, and centering apparatus.

Courses in the different branches of this industry will be given and extended over a period of six weeks. A living wage will be paid to those who take these courses. On completion of the course the student will be in a position to enter one of the optical munition factories and be competent to perform certain of the operations required.

Work of this kind on the grinding, polishing, centering, assembly, and inspection of lenses and prisms for optical systems is not heavy, and is well suited for young women who desire to do their share on war-munitions work. Many young women in this country have been knitting and doing such other work as they are able to do to aid our soldiers and sailors, but have desired an opportunity for more responsible work. Not every woman can become a nurse, and there are still great numbers of young women whose energies are not fully utilized and who are not doing their bit toward winning the war. A good opportunity to do this is afforded by the optical training school at Rochester. Work in optical munitions is most urgent and is of highly responsible character. Optical munition workers are well paid and are contributing directly to American success in this war.

In England two training schools of this nature were established some time ago and have proved most successful. As a result, the manufacture of optical munitions in England is well in hand, and many of the responsible positions are held by young women, not formerly employed, who are serving their country most effectively in this capacity.

Details regarding the courses of instruction can be obtained from Dr. Barker, president of the Mechanics Institute, Rochester, N. Y. The largest factories are located in Rochester, Buffalo, and New York, N. Y.; Boston and Southbridge, Mass.; Pittsburgh, Pa., and Dayton, Ohio.

SUMMER WORK AT THE LABORATORIES OF THE BUREAU OF FISHERIES

WORK at the Fairport laboratory is proceeding with the least possible interruption this summer. Through the cooperation of the permanent employees of the station arrangements for working quarters and living accommodations for a limited number of investigators have been made. Professors C. B. Wilson, Emmeline Moore, and H. S. Davis continue investigations of aquatic insects, plants, and protozoan parasites of fishes, respectively, in relation to fish culture in ponds.

Dr. Albert Mann, of the Bureau of Plant Industry, has been detailed by the Secretary of Agriculture, at the request of the Secretary of Commerce, for special work on the diatom flora of the Woods Hole region. Portions of the laboratory of the Woods Hole station are in the possession of the Navy Department, but laboratory facilities are available for a limited

number of investigators. Superintendent W. H. Thomas has been designated acting director of the laboratory for the season. Dr. George T. Moore, of the Missouri Botanical Garden, assisted by F. B. Dieuaide, will conduct experiments on the production and utilization of algin. Professor Edwin Linton, of Washington and Jefferson College, will continue investigations of the parasites of fishes and the food of flounders and other fishes.

The Beaufort laboratory having been turned over to the Navy Department, no work will be done there this summer.

THE AMERICAN INSTITUTE OF MINING ENGINEERS

In an effort to increase the scope of their war service, the American Institute of Mining Engineers will meet in Colorado during the week of September 2, to take up vital problems of immediate importance. Mining engineers from every section of the country will attend. During the meeting, trips are to be made from Colorado Springs to the Cripple Creek district, Pueblo, the Leadville district and Boulder. The week's session will open in Denver on the second of September, and will that evening move to Colorado Springs, which will be the principal headquarters for the duration of the meeting.

This is the first meeting of the entire institute in Colorado since 1896, and an appropriate entertainment program is being planned by the several hundred Colorado members. One of the special features of the entertainment will be an auto drive to the top of Pikes Peak. The sections of Colorado to be visited are rich in many war minerals of importance including ferro alloys, radium, molybdenite ores and pyrites.

Those who are directing the plans for the Colorado meeting are as follows: Committee in charge, Spencer Penrose, chairman, A. E. Carlton, chairman finance committee, George M. Taylor, vice-chairman, J. Dawson Hawkins, secretary. Denver Committees: (Arrangement) Dave G. Miller, Frank Bulkley, Geo. E. Collins; (Entertainment) F. H. Bostwick, F. E. Shepard, Howland Bancroft, B. P. Morse, J. G. Perry; (Finance) T. B. Stearns, Richard A. Parker, T. B. Burbridge.

THIRD SUMMER MEETING OF THE MATHEMATICAL ASSOCIATION OF AMERICA

It is announced in the *American Mathematical Monthly* that the third summer meeting of the Association will be held by invitation of Dartmouth College at Hanover, New Hampshire, on Friday and Saturday, September 6–7, 1918, in conjunction with, and following, the summer meeting of the American Mathematical Society. A joint dinner will be arranged for Thursday evening, September 5, and at a joint session on Friday morning the subject of the mathematics of warfare is to be treated by men now actively engaged in government service.

During the sessions of the association on Friday and Saturday, Professor Florian Cajori, of the University of California, will deliver his address, as retiring president, on "Plans for a History of Mathematics in the Nineteenth Century"; Professor W. F. Osgood, of Harvard University, will speak "On the Mathematical Formulation of Physical Concepts and Laws as treated in the Calculus"; and Professor F. L. Kennedy, of Harvard University, will give a paper on "Some Experiments in the Teaching of Descriptive Geometry," the discussion being led by Dean O. E. Randall, of Brown University. Other features of the association's program will be announced later.

For a session on Friday members are invited to submit papers on topics of their own choosing. Abstracts of such papers in a form suitable for publication in the Secretary's report of the meeting should be sent to Professor R. C. Archibald, Brown University, chairman of the program committee, not later than August first, in order to be approved by the committee in time for publication in the printed program; authors will please state the time necessary for reading their papers. No other announcement will be made until the program is mailed to members about the middle of August.

The committee on arrangements, Professor J. W. Young, chairman, announces that Dartmouth College will open one of its dormitories for the accommodation of attending members.

A separate entrance, or at least a separate floor, will be provided for ladies or married couples. Meals will be furnished under the auspices of the college at reasonable rates. The rates for the occupancy of dormitory rooms will probably be one dollar per day per person. Persons desiring to stay over Sunday and Monday for the purpose of making excursions into the neighboring hills and mountains can probably be accommodated.

SCIENTIFIC NOTES AND NEWS

Sir William Crookes, O.M., celebrated his eighty-sixth birthday on June 17.

Mr. Horace Lamb, F.R.S., professor of mathematics in the University of Manchester, has been appointed Halley lecturer at Oxford University for next year.

Dr. William S. Thayer, of the Johns Hopkins University, now a colonel in the National Army, has been made a foreign member of the French Academy of Medicine.

A section of Anthropology in the Division of Medical Records in the Office of the Surgeon General, was created on July 23, 1918. Major Chas. B. Davenport, Sanitary Corps, N. A., has been designated as the officer in charge. The functions of this section are to be: To secure the highest quality of the measurement of recruits and of identification records as done by the Surgeon General's Office for the purposes of the War Department; to assist, as called upon, in the analysis and synthesis of the statistics compiled from medical records; to care for and help analyze physical examination records; to care for and classify identification records, and to assist the War Department in all questions about racial dimensions and differences.

Professor E. V. Huntington, president of the Mathematical Association of America, has taken leave of absence from Harvard University and with the rank of major in the national army is assigned to statistical study under the chief of staff with residence in Washington.

Professor A. D. Cole, professor of physics at Ohio State University, is in Washington for the summer, engaged in research work in the Bureau of Standards.

Mr. W. L. Currie, of Glasgow, has been elected president of the Pharmaceutical Society of Great Britain.

The Association of Military Surgeons of the United States will hold its annual meeting for 1918 at Camp Greenleaf, Fort Oglethorpe, Ga., on October 13 and 15, under the presidency of Medical Director George A. Lung, of the U. S. Navy.

By request of the Secretary of War and the Secretary of the Navy the National Research Council has formed a committee on explosives investigations composed of Lieutenant Colonel W. C. Spraunce, Jr., Ordnance, National Army, nominated by the Chief of Ordnance of the Army; Lieutenant Commander T. S. Wilkinson, United States Navy, nominated by the Chief of Ordnance, United States Navy, and Mr. L. L. Summers, representing the War Industries Board, with Dr. Charles E. Munroe, dean of the faculty of graduate studies of the George Washington University, as chairman. The functions of the committee as officially defined are: (1) To survey the investigations on explosives now under way and to keep closely in touch with their subsequent progress. (2) To gather and communicate to the proper military and naval authorities all information available in regard to such investigations. (3) To bring to the attention of the proper military and naval authorities proposals for supplementary investigations relating to explosives, and to arrange for the prosecution of such investigations by the civilian bureaus of the government, by industrial companies and by universities and endowed research institutions. The office of the committee is in the building of the National Research Council at 1023 Sixteenth Street, Washington, D. C.

Drs. C. E. Ferree and G. Rand, of Bryn Mawr College, presented a paper at the fifty-fourth Annual Convention of the American Ophthalmological Society on July 10 on "The Inertia of Adjustment of the Eye for Clear Seeing at Different Distances." A method and apparatus were described for testing for

fitness for aviation and other vocations for which speed and accuracy of adjustment of the eye for clear seeing at different distances are a prerequisite.

In accordance with plans for cooperation of the Bureau of Chemistry and the Bureau of Fisheries on problems of preparation and preservation of fishery products for food, Dr. F. C. Weber, of the Bureau of Chemistry, and Drs. G. G. Scott and W. W. Browne, of the College of the City of New York, temporary assistants of the Bureau of Fisheries, have begun work for the summer at Perkins Laboratory, Gloucester, Mass., where facilities and cooperation are afforded by the Gorton-Pew Fisheries Co.

UNIVERSITY AND EDUCATIONAL NEWS

The University of Chicago has received from Mr. La Verne Noyes a gift of $2,500,000, to be used in the education of soldiers and sailors and their descendents after the war. In addition the fund provides for the perpetuation of instruction in American history and the public duties of citizenship.

Columbia University is a beneficiary under the will of Major Eugene Wilson Caldwell, of the United States Medical Reserve Corps, from two trust funds upon the death of life tenants to support a foundation for general educational work. Dr. Caldwell died in Roosevelt Hospital from burns received while experimenting with X-rays. His estate was valued at more than $150,000.

The Kansas City Veterinary College, after an existence of twenty-seven years, during which it has graduated nearly 1,700 men, has decided to abandon the field of veterinary education. It has transferred to the Kansas State Agricultural College its records and good will, and made arrangements with that institution to take over its students as far as possible and agreeable to them.

The Department of Chemistry of the State College of Washington, Pullman, Washington, announces the establishment of a fellowship, to be devoted to research on the extension of the chemical uses of magnesite, paying $600 a year.

Dr. C. W. McCampbell, for eight years a member of the department of animal husbandry of the Kansas State Agricultural College, is the new head of the department, succeeding Professor W. A. Cochel, who has resigned.

Professor J. H. Ransom, after eighteen years in Purdue University, has accepted the professorship of chemistry and director of the chemical laboratories in Vanderbilt University, Nashville, Tenn.

W. V. Lovitt, Ph.D., Chicago, of the mathematical department of Purdue University, has been appointed associate professor of mathematics in Colorado College.

The electors to the Harkness scholarship in geology in Cambridge University have recommended that the scholarship for women for 1918 be awarded to Majorie E. J. Chandler, Newnham College.

Sir Charles Parsons has accepted the office of president of the Polytechnic School of Engineering, London, in succession to the late Mr. Charles Hawksley.

Dr. Maud Kinnaman, of Washington, N. J., has been made head of the new medical college at Vellore, India.

DISCUSSION AND CORRESPONDENCE

THE FUNDAMENTALS OF DYNAMICS

Most discussions of elementary mechanics refer to variations in point of view and especially to variations of emphasis which are all equally logical and all fully understood by careful students of the subject. Therefore, discussions of elementary mechanics usually say a great deal to "put over" a mere grain of edification, and Professor E. V. Huntington's recent discussions of elementary mechanics in Science and in the *American Mathematical Monthly* is no exception to the general rule. From the most favorable point of view, Professor Huntington's discussion is much ado about nothing; but from our point of view it

is much worse than that. If we were not convinced that Professor Huntington is definitely mistaken in several important matters we would not, for a third time, take part in the discussion.

1. Professor Huntington urges the use of the term *standard weight*, the *weight* of a body in London in "pounds,"[1] instead of *mass*. Now what we call the mass of a body is independent of time and place, it is an invariant[2] relation between the given body and the standard kilogram (a piece of metal), and extraneous and confusing ideas would be involved in the term *standard weight*, because this term implies location and a relationship between the given body and the earth. How awkward it would be, for example, to be obliged always to speak of the distance d between two points (x, y, z) and (x', y', z') as $[(x-x')^2+(y-y')^2+(z-z')^2]_{\frac{1}{2}}$. This function is an invariant, and the most useful name or symbol for it is a name or symbol which carries no redundant suggestions as to particular axes of reference, *and this would be true even if we had always to make use of particular axes of reference in the measurement of d.* The word *mass* is widely used by physicists and chemists for an idea which is independent of time and place and which does not involve any relationship with the earth (this is true even though mass be determined by weighing), and it is simply out of the question to use for this idea the term *standard weight* with its redundant and misleading suggestions.

2. To be unfriendly to the term *mass* and to prefer the term *standard weight* is of course a small matter; but Professor Huntington seems to go much deeper than mere terminology. He insists, for example, on the equation $F/F' = a/a'$ as THE fundamental equation of dynamics, although several correspondents in SCIENCE have called his attention to the fact that acceleration not only varies from force to force for a given body *but also from body to body for a given force*. Both of these fundamental modes of variation must be formulated as fundamental equations of dynamics. Professor Huntington states[3] that the variation-from-body-to-body-for-a-given-force is logically derivable from the variation-from-force-to-force-for-a-given-body, and the object of the following discussion is to make it clearly evident that Professor Huntington's statement is not true.

[1] The "pound" here means the pull of the earth on a one-pound body in London.

[2] No consideration is here given to variations of mass as recognized in the recent developments of the principle of relativity.

Given three bodies A, B, and C, and three identifiable forces a, b and c. Let the acceleration of each body due to each force be *observed*, the results being shown in the accompanying table. Let us suppose that the table has been

TABLE OF OBSERVED ACCELERATIONS

		Bodies		
		A	B	C
Forces	a	25	30	35
	b	50	60	70
	c	75	90	105

extended so as to include a great many different forces and a great many different bodies, then a careful inspection of the table would lead to the following generalizations:

(*a*) If one force produces twice as much acceleration as another force when acting on a given body, then the one force produces twice as much acceleration as the other force when acting on *any body whatever*.

(*b*) If one body is accelerated twice as much as another body under the action of a given force, then the one body is accelerated twice as much as the other body under the action of *any force whatever*.

The experimental fact (*a*) makes it convenient to define the ratio of two forces as the ratio of the accelerations they produce when acting on a given body, because this ratio is the same for all bodies.

That is

$$\frac{F}{F'} = \frac{a}{a'}, \tag{1}$$

[3] SCIENCE, March 3, 1916, page 315.

where a is the acceleration of a given body produced by force F, and a' is the acceleration produced by force F'.

The experimental fact (*b*) makes it convenient to define the ratio of the masses of two bodies as the inverse ratio of the accelerations produced by a given force, because this ratio is the same for all forces.
That is

$$\frac{m}{m'}=\frac{a'}{a}, \tag{2}$$

where a is the acceleration of body No. 1 and a' is the acceleration of body No. 2, both produced by a given force, and m and m' are the masses of the respective bodies.

We prefer to define mass quantitatively in terms of the operation of weighing by a balance scale and to look upon equation (2) as an experimental discovery; but in any case equations (1) and (2) are independent and they are the fundamental equations of dynamics.

Equation (1) applies to a given body, and pure logic would not even know of the existence of another body, so that equation (2), inasmuch as it refers to at least two bodies, can not be a logical consequence of equation (1). It is surprising to us to have Professor Huntington refer[4] to the above table of observed accelerations in support of his statement that equation (2) is a logical or mathematical consequence of equation (1). Of course we have not observed these accelerations, but in the last analysis they are dependent on observation and upon nothing else.

3. Professor Huntington's statements as to systematic units are very much like most current text-book statements touching this matter. "Fundamental units may be chosen at pleasure"—so all of our talking physicists say, mentioning only the evident condition that material standards thereof must be carefully preserved. Working physicists, however, know that the fundamental quantities must be susceptible of very accurate measurement under all sorts of conditions and in all kinds of relations *because the definition of a derived unit can not be realized with greater accuracy than the fundamental quantities can be measured.* Think of the years of confusion in electrical measurements when the theoretical ohm could not be produced with greater accuracy than, say, one per cent., but when almost anybody could make resistance measurements to, say, a hundredth of one per cent! When we recall that old nightmare we are inclined to smile at the childish pleasure with which many teachers talk about choosing fundamental units. Indeed, one fundamental unit would be enough if certain measurements, which would then be fundamental, could be made with sufficient accuracy. This important condition of *accurate realization of derived units* makes it undesirable to use the pull of the earth on a one-pound body in London (or on a one-gram body) as a fundamental unit in any universally practicable system. As a matter of widest practise the use of the unit of force as a fundamental unit is out of the question. We admit, however, and here we differ from some of our colleagues in physics, that the C.G.S. system (or the F.P.S. system) is less convenient than the foot-slug-second system in some fields of engineering.[5]

4. It is extremely amusing to read Professor Huntington's naïve suggestion that a unit of force might be preserved in the form of a standard spring. This is laughable for two reasons, namely, (*a*) because the pull of the earth on a one-pound body in London is perhaps as invariable as its mass so that no standard spring is needed to preserve a unit of force, and (*b*) because, as every working physicist knows, the most carefully "aged" springs grow very perceptibly softer in time. Tempered steel and phosphor bronze and fused quartz are unstable substances.

5. We are at a loss to understand the significance of Professor Huntington's efforts to establish order in the fundamental view points of mechanics except on the assumption that he has felt, somewhat vaguely, the central fallacy,

[4] Science, March 3, 1916, page 315.

[5] We publish in a current number of the *Bulletin* of the Society for the Promotion of Engineering Education a brief and simple discussion of this subject, a discussion which we think may show the way to a general agreement among writers on mechanics.

namely, (*a*) the willing agreement among all technical writers to use the word *weight* to designate the earth pull on a body, followed by (*b*) a careless reversion to the usage of the coal man and the acceptance of his meaning when he sends a bill for 2,000 pounds weight of coal! Let it be understood that the coal man's weight is precisely the physicist's and the chemist's mass. The balance scale measures mass, it does *not* and can not measure *force* in any precise sense until the ratio of the local value of gravity to the value of gravity in London is known.

WM. S. FRANKLIN,
BARRY MACNUTT

THE CANONS OF COMPARATIVE ANATOMY

IN a recent number of SCIENCE[1] Professor W. P. Thompson refers to a recent letter of mine to that journal. He maintains that the assertion on my part that he made use of the Canons of Comparative Anatomy through ignorance to reach an erroneous conclusion is inaccurate. This seems to be contrary to the facts, since Professor Thompson on his own showing is culpable either of inexcusable ignorance or deliberate misrepresentation. He emphasizes the value of the genus *Vaccinium* as a type illustrative of the relations between two main forms of vessel in the angiosperms, namely, the one with scalariform perforations and that with porous perforations. Had his acquaintance with the anatomy of *Vaccinium* been more complete, he would have realized that the type of vessel found in the Gnetalian genus *Ephedra* is also present there. Contrary to Mr. Thompson's statement, moreover, vessels of the *Gnetum* type prevail in the higher angiosperms rather than in the lower ones, being universal, for example, in the Compositæ and extremely common in the monocotyledons. It is unfortunate that Professor Thompson either through ignorance or intention has failed to emphasize the presence of the *Gnetum* type of vessel in the angiosperms, particularly as in many cases it has in that large group a mode of origin similar to that described by him in the case of *Gnetum*. It thus appears that his contention that the *Gnetum* and *Ephedra* types of vessels are fundamentally different in origin from those of the angiosperms is without foundation in fact, since both these types are actually present in quite high angiosperms. Professor Thompson's attitude is further highly inconsistent, since in earlier publication he has called attention to the resemblances between the wood rays of *Ephedra* and those of certain angiosperms, and to the occurrence of nuclear fusions in *Gnetum* which he compares with that found in the case of the endosperm nucleus of the angiosperms.

E. C. JEFFREY

[1] N. S., Vol. XLVII., No. 1221.

WHOLE-WHEAT BREAD

TO THE EDITOR OF SCIENCE: As a contribution to the discussion "Shall We Eat Whole-wheat Bread,"[1] may I quote from the findings of a special committee appointed by the Royal Society of England, to study this matter,[2] as follows:

The bread now in use is prepared from grain milled to 90 per cent. with the addition of other cereals. After investigation, a committee of the Royal Society has issued a report on the following questions: (1) What gain, if any, in food value accrues from a rise in the milling standard from 80 to 90 per cent., and does the dilution of wheat flour with other cereals modify the food value of the bread? (2) What would be the effect on the health of the consumption of such breads? (3) How far would such breads prove acceptable? Experiments were made with wheat flour, extracted to 80 and to 90 per cent. The analytical work was done in the biochemical department of the University of Cambridge and in the physiological laboratories of the universities of Glasgow and London. The diet consisted of 800 gm. of bread with butter, cheese, minced or potted meat, fruit jelly, milk and sugar, tea or coffee, and in one case beer was taken as a beverage. This dietary yielded about 3,680 calories a day. *The effects were remarkably uniform.*[3] Bread made from the 80 per cent. flour yielded for nutrition 96.1 per cent. of the energy contained in the diet; bread made from 90 per

[1] "The Conservation of Wheat," SCIENCE, Vol. XLVII., No. 1218, p. 429; SCIENCE, N. S., Vol. XLVII., No. 1210, p. 228, March 8, 1918.

[2] Copied from the *J. Amer. Med. Assn.*, Vol. 70, No. 22, p. 1619, June 1, 1918.

[3] The italics are my own.

cent. flour, 94.5 per cent. The loss of energy with the second bread was greater (5.5 per cent.) than with the first (3.9 per cent.). The intestinal secretions were considered to contribute largely to this. The feces with the 90 per cent. bread were more bulky, and the coarser particles of this bread produced a greater stimulation of the secretion of the intestine. The increase in the bulk of the evacuation is not an evil and in the case of many is even an advantage. As to the nitrogenous constituents, the average digestibility was 89.4 per cent. in bread made from flour extracted to 80 per cent., and 87.3 per cent. in that extracted to 90 per cent. In most of the cases there was a slight gain in body weight with both breads. Thus a *greater proportion of the energy of the grains is available for human consumption when flour is milled at the 90 per cent. scale than on the 80 per cent. scale. The increase would extend the cereal supply of energy for the country for more than a month.* Against this is to be set the loss of protein in the offal as food for pigs. Another set of experiments were made with bread made from flour consisting four fifths of wheat extracted at 80 per cent., and one fifth of maize. At first the flavor of the maize was commented on, and there was in some cases disturbance of digestion, attended sometimes with diarrhea, and more often with constipation; but these symptoms passed off. The general conclusion is that bread made with the addition of maize flour was as digestible as bread made without it, and it was well digested by children. The addition of maize made practically no difference in the utilization of energy and nitrogen. Observations were made at a canteen on the dietetic effects and *on the palatability of bread made from flour containing four fifths of wheat extracted* to 90 per cent., and one fifth of other permitted cereals (10 per cent. barley, made up to 20 per cent. with maize and rice, or rice alone). It was found *to be palatable* and *never to cause indigestion.*

These conclusions seem to strongly support my former statements that the "attack on the higher extraction flours is unmerited" and "that higher extraction flours are not normally harmful" and also when these flours are used more generally over the country "more grain will be released for the allied armies."

R. Adams Dutcher

SCIENTIFIC ACTIVITY AND THE WAR

The Italian mathematician G. Vivanti opened the preface of his book entitled "Equazioni Integrali Lineari," 1916, with the following words:

While our sons fight valorously to liberate Europe from the Teutonic yoke it devolves on us, whose age and strength do not permit to offer arms to our country, to work for its scientific emancipation. A *national* science is an absurdity and he would be foolish who would refuse a scientific truth because it arose from beyond the Alps or the sea; but the work of scientific exposition and publication can be and ought to be national. Who does not recognize a German treatise by its minute and sometimes wearisome care of particulars, an English by its good-natured and discursive tone, a French by its form which is sometimes a little vague but always suggestive and elegant?

These words of an Italian scholar may be of especial interest at this time when so many of us are considering the question of how to render the most effective service to our country. It is interesting to note that Vivanti emphasized scientific exposition and publication as a means towards securing scientific emancipation. While scientific investigation should always occupy the foremost place in a permanent scientific program, it must be admitted that there is danger in fixing our attention too completely on the most important element in our scientific progress. Our students should not have to feel that the great majority of the best expository works relating to their subject are to be found only in the language of a people of low ideals imbued with a morbid desire to dominate the world at any cost.

From a quotation found on page 9 of the May, 1918, *Bulletin of the American Association of University Professors*, it appears that the German professors are still very active in the production of scholarly works, while those of England and France are devoting themselves much more completely to direct service connected with the war. This direct service is probably a natural concomitant of the high ideals which prevail in these countries, but it is evident that it points to the possibility "of winning the war in a military sense, only to find ourselves dominated by German knowledge and German science!"

The preparation of scholarly works of the

highest possible order at the present time is thus seen to be a patriotic service, which should be considered very seriously by those who are in position to render it. The uncertainty as regards prompt publication only adds to the credit due to those who are undertaking such service at the present time as far as opportunities connected with direct work for winning the war are not jeopardized thereby. It is perhaps reasonable to expect that scientific publications in the English language will find a wider market after the war than before, and that the public will then have acquired a higher appreciation of the nation's need of science.

It is perhaps especially important to emphasize the need of a vigorous development of pure science at this time in order that the applied sciences whose active development is being encouraged by immediate needs may not suffer later on account of a lack of theoretic impulses. The fact that applications do not always appear along expected lines was recently emphasized by H. Lebesgue in a review published in the *Bulletin des Sciences Mathématiques,* April, 1918, where he refers (page 94) to the fact that from the time elliptic functions were first discovered about a century and a half ago, mathematicians decided that they should have practical uses. Up to the present time the only applications of elliptic functions are the applications of mathematicians, who still await the first confirmation of their *a priori* idea as regards their practical usefulness.

G. A. Miller

University of Illinois

SCIENTIFIC BOOKS

Patenting and Promoting Inventions. By Moïs H. Avram, M.E., New York. Robert M. McBride & Co. 1918. Pp. 166. $1.25, postage extra.

By reason of the comprehensiveness, balance and candor of its brief discussions, this little volume seems to deserve clear differentiation from the familiar and misleading booklets designed merely to promote the soliciting business of firms advertised thereby. Beginning with its preliminary chapter (a general survey) entitled Why Inventors Fail, and throughout the seven successive chapters covering in outline the evolution of the patent system, the United States patent practise, the patenting of inventions abroad, patent attorneys, and expert investigations extending even into the very practical collateral questions of manufacture, markets and financing, there is however maintained a natural emphasis upon the need, shared by the inventor and the investor, for advice and assistance on the part of those technically qualified. In proportion as this need seems both real and permanent, in the complex industrial organization from which there seems no possibility of a return, such emphasis seems timely.

In his references to those who have to do with the work and administration of the Patent Office the author is not ungenerous. The uncertainties at present inherent in the development of inventions are neither exaggerated nor concealed. But not every reader may be able to share the author's apparent conviction that a timely resort to expert private advice would notwithstanding save the day for the inventor or the investor. Disregarding the fact that there are, of course, experts and "experts," it may be suggested, by way of supplement, that so long as there shall continue at the Patent Office a rapid flux in its inadequate and disheartened force, apparent defects in its organization and in its informative resources and an atmosphere of legal technicality, without due time or incentive for a broad consideration of scientific, economic or equitable considerations, there can be little hope for such service and security as the patent system was designed to afford. To the reviewer, it is accordingly a matter of gratification to find that the need for collective effort, involving some legislative action, is appreciated, even though it is not stressed in the work under review.

Although perhaps hardly pretending to the solidity of a work of reference, this volume seems sufficiently comprehensive and exact to justify the inclusion, in any subsequent edition, of such an index as would facilitate

ready reference to numerous minor topics—such as reissues, disclaimers, forfeitures, interferences—which are discussed in brief but effective subordinate paragraphs.

Bert Russell

RECOMMENDATIONS OF THE AGRICULTURAL ADVISORY COMMITTEE

Secretary Houston has received the recommendations of the agricultural advisory committee reported at the conclusion of its meeting in Washington, June 27 to July 2. The following are among the most important subjects considered by the committee:

1. Indorsement of Henry C. Stuart, chairman of the agricultural advisory committee, for appointment on the War Industries Board as representative of agriculture.

Following is the text of the resolution:

Resolved, That the full committee indorses the action of the executive committee in asking for the appointment of the Hon. Henry C. Stuart, the chairman of the Committee, upon the War Industries Board.

2. Facts were submitted to the committee showing that the harvest of spring wheat would come at a season when soldiers would probably just be entraining for military services, and they would therefore be lost to the wheat harvest in the spring wheat region. The committee, therefore, passed a resolution, to be presented to Provost Marshal General Crowder, asking that temporary deferred classification be granted to the men called July 22–27, before their entrainment, that they might help in the harvest before leaving home, rather than to report at their cantonments and then be furloughed back, thus saving expenses to the government and preventing a loss of time for the men.

3. A full discussion was had of the unusual car shortage and the delays in the shipments of live stock and grain during the past winter, resulting in large financial loss to the producers. Attention was called to the fact that transportation conditions were still unsatisfactory and the Department of Agriculture and the Food Administration were requested to take up the matter again with the Railroad Administration, with the view of insuring relief in these matters. A subcommittee on transportation was appointed, of which Henry C. Stuart was chairman, to act with the two departments in placing this matter before the Director General.

4. Consideration was given to criticisms that had been made in regard to the application by division heads of the rules and regulations of the War Industries Board regarding wool. There seemed to be ground for believing that some of the interpretations of the rules worked a hardship on the wool growers. A subcommittee was appointed to look into this matter and make such recommendations as seemed to them necessary to a readjustment of the matters complained of, and a recovery of losses incurred, if any.

5. The committee devoted a large portion of its time during the first three days of its session to a discussion of the grades and prices of wheat in which Mr. Hoover and members of his staff, with representatives of the Grain Division and the Bureau of Markets of the Department of Agriculture, participated. Practically all of the recommendations of the committee were provided for in the final draft of the announcement issued July 1.

A subcommittee had formulated an expression of suggested explanations of terms and conditions that were thought to be helpful in giving the farmer a clear understanding of the regulations and his personal status in their administration.

These suggestions were heartily indorsed by the full committee and the Food Administration.

6. A resolution was passed giving indorsement of the plan of the Bureau of Animal Industry for stamping out tuberculosis in cattle. Suggestions were made that some of the plans might be slightly modified in the matter of facilitating the disposition of tubercular animals.

7. Whereas the Department of Agriculture has submitted for our consideration a proposal for the elimination of certain less essential types or designs of farm machinery and parts thereof, giving as a reason therefor that because of the war

demands the allotment of steel for the manufacture of farm machinery must be limited to the amount strictly necessary to enable our farmers to maintain crop production, and that the multiplicity of types and designs now existing places an unnecessary burden upon steel mills in preparing steel and iron therefor; and whereas we believe the reasons given are just and valid and that the demand upon us is in line with the demands made upon other industries: Therefore be it

Resolved, That we indorse the schedule of eliminations submitted by the Department of Agriculture, with certain minor changes, with the understanding and with the assurance on the part of those who have prepared the schedule that no change in design of any implement has been made which will lessen its strength or efficiency, and no machine or implement has been eliminated which is essential for the efficient production of agricultural products in any extensive region, and the work performed by which can not be as efficiently done by other machines, the manufacture of which shall be permitted. We recommend, however, that measures be taken to afford full protection to farmers owning machines of types eliminated by requiring that manufacturers make and place on the market repair parts for eliminated machines or eliminated parts of machines for a length of time equal to the average normal life of such machines or parts.

The committee passed resolutions urging the Department of Agriculture to insist on the standardization of parts of farm implements, such as cultivator teeth, mower and harvester guards, mower and harvester sections, threads on bolts, skeins on wagons, surface cultivator knives and many other parts on which patents have expired. It was the opinion of the committee that this would result in very material economy in every way and increased convenience to the farmer in securing implement parts.

8. After discussing the prevalent prices of farm machinery and the advances made during the past three years, the committee passed a resolution asking for an investigation at the earliest possible date, into the cost of manufacturing farm implements and asked that the industry be required to operate on a basis of cost plus a reasonable profit.

9. The committee recorded its appreciation of the good work done by the Food Administration in increasing the consumption of potatoes, thus partially relieving the stress arising from the production of a heavy spring crop in the south, with large storage stocks held over in the north.

The promotion of war gardens was commended, as it was believed by the committee that the results not only showed a larger supply of fresh vegetables but converted many acres to the growing of staple crops that helped to increase the total food supply and to lessen transportation difficulties.

The Department of Agriculture was commended for its work in the selection and breeding of potatoes in the various potato-growing sections.

Much interest was expressed in the dehydration of vegetables, especially potatoes, and it was recommended that this work should be followed up.

Record was filed, briefly reviewing the poultry conditions of the country, showing that although the price of poultry had not advanced in keeping with the price of feeds, more eggs have been shipped and stored than at the same time in 1917, this being partly due to the early warm season and partly to the patriotic adherence to the industry in spite of adverse conditions.

A resolution was passed expressing the opinion of the committee that the vegetable forcing industry was important, and so blended with the forcing of plants for field crops, that the industry should be fostered and protected as far as the exigencies of the war may permit.

10. On reports of members of the committee from the west and south where wheat has already been harvested, regarding the highly efficient service rendered by the Farm Labor Division of the United States Department of Agriculture and the Federal Department of Labor, in the mobilization and distribution of harvesters to the wheat fields of the south and west up to the present time, the committee asked for a continuation of this service to the completion of the harvest in the spring-wheat region.

11. The following resolution was adopted by the committee:

WHEREAS absolute war necessity and shortage of wheat for export has required that, in the exchange milling of his own wheat, the farmer be restricted to a supply of flour equal to his household needs and those of his farm employees for 30 days; and

WHEREAS the present crop prospect seems to make this necessity less acute, be it

Resolved, That the Food Administration be requested to remove this restriction as early as conditions will allow.

12. The committee was of the opinion that groundrock phosphate and acid phosphate should have the same freight classification as agricultural lime, taking an increased freight rate of one cent a hundred pounds, instead of an increase of 25 per cent., as applied to general commodities, and it was directed that request be made to the Director General of Railroads that the desired classification be granted.

13 Resolutions were passed by the committee favoring:

(1) Regulation of the use of mill feeds by the mixers of proprietary feeds, so as to secure to the dairyman the benefits of the efforts of the Food Administration to lower the price of mill feeds.

(2) Regulation of the manufactories of mixed feeds.

(3) Equitable distribution of mill feeds.

(4) Use of sugar substitutes in ice cream manufactories.

(5) The disallowance of sugar to manufacturers of ice cream failing to comply with reasonable standards of butter fat and solids not fat.

(6) Purchase of dairy products by Army and Navy.

(7) Expression of appreciation to the Food Administration for the publicity given to the economic value of milk.

(8) Recommendation to the government to extend the standardization of dairy and other agricultural products.

(9) Commendation to the market report service by the Bureau of Markets.

The subcommittee on dairy products presented to the tariff department of the Railroad Administration an explanation of the hardship upon the small shipper of milk and cream, because of the minimum charge of 50 cents on any individual shipment.

The regulation was promptly modified so as to nullify the application of a minimum charge.

SPECIAL ARTICLES

THE RELATION OF THE RATE OF BLOOD FLOW THROUGH THE MEDULLA OBLONGATA TO THE AMPLITUDE AND FREQUENCY OF RESPIRATORY MOVEMENTS

ALTHOUGH the relation to respiratory movements of the changing concentrations of carbon dioxide in the blood, and of afferent nerve impulses from the lungs to the medulla oblongata has long been recognized, a third factor entering into the equation, *i. e.*, the rate of blood flow through the medulla oblongata, has received but little consideration. Haldane[1] mentions the rate of blood flow as one of the factors, but the emphasis, as is natural in pathology, is placed mainly on the general disturbances of the circulation.

Some years ago I repeated Sir Astley Cooper's old experiment of ligating permanently both common carotid and both vertebral arteries close to their origin in dogs. The experiments were done aseptically and the animals allowed to live. The chemical analyses of the brains of these animals were published by Waldemar Kock and S. A. Mann.[2] The general results of the ligation were similar in all essential respects to those noted by Leonard Hill.[3] Hill remarks that in one dog, there was preliminary acceleration of the respiration following the ligation of the four arteries.

I noticed respiratory disturbances in some dogs, and one in particular attracted my at-

[1] "Text Book of General Pathology," edited by M. S. Pembrey and James Ritchie, London and New York, 1913, chapter on Respiration; Organism and Environment as Illustrated by the Physiology of Breathing, New Haven, 1917, pp. 5–6.

[2] Mott's "Archives of Neurology and Psychiatry from the Pathological Laboratory of the London County Asylums," London, 1909, IV., pp. 211–12; Studies from the Rockefeller Institute for Medical Research, X., 1910, p. 38 of the reprint.

[3] "Physiology and Pathology of the Cerebral Circulation," London, 1896, p. 123.

tention. When lying quietly at rest, there was no apparent change in the respiration. No graphic records or measurements of the minute volume were taken. But when the dog was urged to rise and walk about, it at once began to pant violently. On lying down again, the panting ceased. Other dogs with normal cerebral circulation did not pant except after much greater exertion.

Hill states that none of his dogs died after ligation of the four cerebral arteries, but he does not mention the age of his dogs. I have found that vigorous, full-grown dogs survive the ligation indefinitely, but half-grown pups and old dogs usually succumb within twenty-four hours. I have seen half-grown pups lie unconscious for several hours, sometimes panting violently, and sometimes making ineffectual movements of locomotion with the fore limbs. Attempts to rouse them from this state were unsuccessful, and they were usually found dead the next morning.

Hill remarks that there must be a certain blood pressure resulting in the flow of a certain amount of blood through the medulla oblongata in order to provoke respiration. My experience tends to confirm Hill's conclusion. It is a striking thing to see an animal with failing respiration at a low blood pressure improve rapidly when the pressure is artificially increased.

In the dogs with restricted cerebral circulation, there was no apparent deficiency in the rest of the systemic circulation in those which recovered. Nor is there any reason to suppose that there was any change in the blood which would decrease its power of carrying either oxygen or carbon dioxide. It does not seem improbable that, in the dog with the marked respiratory disturbance, one would have found a somewhat greater concentration of oxygen and a somewhat lower concentration of carbon dioxide in the blood than in dogs with normal circulation. The condition in the medullary center itself, in which carbon dioxide might tend to accumulate in somewhat greater concentration than usual, would seem sufficient to account for the dyspnœa on moving about. A lower concentration of carbon dioxide in the blood would be the natural result of the forced respiration. In cases of shock resulting from abdominal wounds on the battle field, in which there was no deficiency of the systemic circulation prior to the wound, it does not seem necessary to assume the production of any large quantities of acid in the body to account for the lower concentration of carbon dioxide in the blood of such patients. It seems sufficient to suppose that, as the systemic blood pressure falls progressively lower, there would be a deficient blood supply to the respiratory mechanism in the medulla oblongata. The natural result would be an increase in the volume of respiration, and a decrease in the concentration of carbon dioxide in the blood. This would not in itself be a sufficient reason for postulating acidosis as a causative factor in the early stages of shock. Whatever acid might accumulate in the tissues might result, as Haldane[4] suggests, from the deficient supply of oxygen to the tissues.

F. H. Pike
The Department of Physiology,
Columbia University

ON THE HYDROLYSIS OF PROTEINS IN THE PRESENCE OF EXTRANEOUS MATERIALS AND ON THE ORIGIN AND NATURE OF THE "HUMIN" OF A PROTEIN HYDROLYSATE

In a recent paper McHargue[1] attempts to show that the nitrogen distribution of casein is not appreciably altered when hydrolyzed in the presence of five times its weight of starch providing that the hydrolysis is continued for only 12–15 hours. McHargue reaches a conclusion which is decidedly at variance with that reached by myself[2] and by Hart and Sure,[3] *i. e.*, that the presence of carbohydrates seriously vitiates the nitrogen distributions of a Van Slyke analysis and he explains the difference in the findings by his shorter hydrolysis. However, he makes several astonishing

[1] J. S. McHargue, *J. Agr. Res.*, Vol. 12, pp. 1–7 (1918).

[2] R. A. Gortner, *J. Biol. Chem.*, Vol. 26, pp. 177–204 (1916).

[3] E. B. Hart and B. Sure, *J. Biol. Chem.*, Vol. 28, pp. 241–49 (1916).

[4] *Loc. cit.*

statements in his paper to which it seems worthy of calling attention.

He states:[1]

> In the footings of the different analyses it will be noted that the 12-hour digestions give footings more than 2.5 per cent. over 100. In the 15-hour digestion the footing is good, while in the 24- and 48-hour digestions the footings are 2.75 per cent. less than 100, thus indicating that the 12-hour experiments were probably not completely hydrolyzed; whereas the 15-hour digestion was sufficient to bring about complete hydrolysis and the 24- and 48-hour experiments were over-digested to the extent that nitrogen was lost.

One can but wonder where he secured such reasoning, or it is needless to point out that not more than 100 per cent. of the original nitrogen can be present in a protein hydrolysate even if complete hydrolysis has not taken place and the literature of proteins shows that no nitrogen is lost by overhydrolysis. Gortner and Holm[4] recently hydrolyzed fibrin for 6 weeks and obtained a recovery of 99 per cent., while 201 hours' hydrolysis showed a recovery of 100.7 per cent. the figures being, in both instances, within the experimental error of the analyses.

However, his most astounding conclusion is that the nitrogen in the insoluble residue obtained from the casein starch digestion "*is in an inert form and its estimation should not be included in the humin determination,*" with the result that he ignored the presence of nitrogen in this fraction in calculating his nitrogen distribution. Unfortunately he does not tell us how much nitrogen remained in this fraction[5] so that we can not recalculate his data, and as a result all of his laborious analyses are worthless. I use the word "astounding" in the above sentence advisedly, for in all of the protein literature I can find no reference to the black humin of protein hydrolysis which does not define it as insoluble, unreactive and inert, and any one who has studied its properties knows well that it is one of the least reactive of the chemical substances ordinarily met with, resembling in much of its behavior ordinary bone black. The humin of protein hydrolysis is a black, granular, noncrystalline substance, insoluble in the ordinary organic solvents, somewhat soluble in alkalis from which solution it is precipitated again by acids, and, in short, the true humin of protein hydrolysis agrees in every respect *as regards physical properties* with the material which McHargue discards and refuses to call humin.

Then again, the nitrogen of the fraction which he discards certainly belonged to the original casein, for his starch was practically nitrogen-free. How then can he claim that hydrolysis in the presence of starch does not alter the nitrogen distribution? This nitrogen which he discards belonged to the original protein molecule and should be included in the starch hydrolysates if it is included in the original casein analysis with which the starch hydrolysates are compared.

As I have shown previously (2), hydrolysis in the presence of carbohydrates causes a very considerable increase in the insoluble humin fraction and this increase is due to both chemical and physical causes. The nitrogen in the true humin of a protein hydrolysate has its origin almost wholly in the tryptophane molecule[6] and the reaction by which it is formed appears to be the condensation of tryptophane with an aldehyde or ketone. When carbohydrates are present the acid causes the formation of furfural which condenses with the tryptophane to form a "humin." However, furfural itself has the peculiar property of polymerizing(?), in the presence of 20 per cent. hydrochloric acid, to a black insoluble substance with the result that a large mass of porous black material is formed in the hydrolysate and this material, presumably through *physical* means, retains a very considerable amount of non-tryptophane nitrogen which normally would not appear in the humin fraction. *Perhaps* these latter forms of nitrogen would not be present in the black mass formed from the furfural in as great a quan-

[4] R. A. Gortner and G. E. Holm, *J. Amer. Chem. Soc.*, Vol. 39, pp. 2736–2745 (1917).

[5] He does give the per cent. of nitrogen in the black material but not the weight of the black material.

[6] R. A. Gortner and G. E. Holm, *J. Amer. Chem. Soc.*, Vol. 39, pp. 2477–2501 (1917).

tity in a twelve-hour hydrolysate as in a forty-eight-hour hydrolysate, but there is no question but that a part of the tryptophane nitrogen would be in this fraction.

It is of interest to note that McHargue obtained no "insoluble humin" for the twelve-hour hydrolysate of casein to which no carbohydrate had been added, and that his "histidine" fraction is in excess of that reported by other analysts. This observation accords beautifully with the idea of Gortner and Holm[6] that an aldehyde or ketone must be present to cause insoluble humin formation from tryptophane and that when insufficient aldehyde is present and the hydrolysis is not sufficiently prolonged the tryptophane will be (in part) precipitated by phosphotungstic acid and augment the "histidine" fraction [cf. Gortner and Holm[4]].

However, all of this discussion, pertinent as it may be, would be trivial were it not for the fact that other workers may be led to accept McHargue's conclusions and thus cause a further waste of money and energy in pursuing an illusive will-o'-the-wisp.

In the introduction to his paper McHargue seems to argue that Van Slyke's method may be applied directly to feeding stuffs without necessarily securing inaccurate results. Even if we should grant that the presence of carbohydrates *per se* did not vitiate the results, and all available evidence is contrary to such a conclusion, there would still remain other forms of nitrogen than proteins in the feeding stuffs which must necessarily appear in the various fractions and be wrongly calculated as amino acids. For example, Steenbock[7] reports the presence of stachydrin in alfalfa and this substance would be calculated as "histidine" in a Van Slyke analysis. I have elsewhere[2] fully discussed this point and therefore have no hesitation in making the following statements: (1) Proteins can not be hydrolyzed with 20 per cent. hydrochloric acid at atmospheric pressure in the presence of a considerable quanity of carbohydrates without appreciably altering certain of the nitrogen fractions of a Van Slyke analysis, and (2) a Van Slyke analysis applied to feeding stuffs, containing as they do non-protein nitrogenous compounds, gives no valid index as to the presence or absence of any individual amino-acid.

Ross Aiken Gortner

Division of Agricultural Biochemistry,
University of Minnesota

[7] H. Steenbock, *Sci. Proc. Soc. Biol. Chem.*, XXVII., 1916; *J. Biol. Chem.*, Vol. 29 (1917).

THE ACADEMY OF SCIENCE OF ST. LOUIS

At a meeting held on May 20 Professor Francis E. Nipher stated that he had been making observations on local variations in the electrical potential of the earth, due to local thunderstorms. The large masses in the Cavendish apparatus are connected with a wire passing through a window in the second story of the physics building to the earth. The wire is in contact with wet grass in the yard below, and with metal rods which are pushed down into wet ground to a depth of about 15 inches. The lightning rod which grounds a high metal tower on the building, which was formerly used for wireless telegraphy, has been broken near the earth, and a gap of about two inches has been made in the rod. This rod can at any time be put in metallic contact with the large masses, by means of a knife switch. On several occasions during storms, sudden changes in the attraction of the large masses upon the suspended masses within the metallic shield have occurred, which it seems impossible to explain except as due to enormous changes in the potential of the large masses, due to local changes in the electrical potential of the earth. Previous results show that this would change the gravitational attraction between the masses.

N. M. Grier,
Recording Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, AUGUST 9, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

SOME ENERGY RELATIONS OF PLANTS[1]

THE science of botany is about one hundred and fifty years old. Great changes have occurred during this time in the point of view from which botanists look at the plant.

The first scientific interest in plants was in merely naming them. In the latter part of the eighteenth century Linnæus extended the use of generic names which were already in use, added species names for greater convenience in handling his herbarium specimens, and thus established the binomial system, now in universal use in naming plants. Thus was laid the foundation of taxonomy as the earliest phase of the science of botany.

Linnæus clearly saw that the next step in the advance of botanical knowledge was to be classification. He himself made some crude attempts at arranging plants in classes. His system he well knew to be artificial. He clearly foresaw that more complete knowledge of the structure of plants, particularly of their buds, flowers and fruit, would ultimately lead to the classification of flowering plants in a natural system. His successors were busy with the attempt to learn enough of this structure of reproductive parts to enable them to put plants into a systematic classification according to their natural relationships.

This gave rise to morphology as the second great phase of the advance of botanical

[1] Address as retiring president of the University of Washington Chapter, Sigma Xi, Seattle, June 4, 1918.

science. It has gone a long way toward its goal of securing and interpreting data bearing on the order of the evolution of the various groups of plants and of thus putting classification on a natural basis. Morphology stands to-day with somewhat changed ideals as one of the big phases of modern botany. Contributing to evolution and working along with it, it offers a large field for investigation. A little later men began to interest themselves especially in the functions of plants—how they make their food, and from what raw materials it comes. This gave rise to plant physiology, the science which lies at the basis of the problems of plant production.

Following this, the destruction of growing crops by parasites led to a scientific study of the organisms that cause plant diseases. This interest in the mutual relation of host and parasites is the foundation of plant pathology, a subject having large possibilities in increasing food production as well as attractive from the standpoint of pure science.

In 1895 the publication of Warming's book focused interest on a new point of view in botany—that of plant societies living together as communities, limited as well as favored by a common environment, but not grouped at all according to their natural relationships in a morphological sense. This has given rise to ecology—a somewhat unorganized, but hopeful phase of modern botany.

We now have, then, four main lines of interest in modern botany—morphology and evolution, pathology, physiology and ecology. In the broadening of our knowledge of plants and of our interests in them, we have gotten far from the point of view of those who looked upon plants as merely things to be named—of those whose interest in plants was merely in the ear marks that might be useful for identification. In the shifting of interest from this mere naming of plants to their natural classification as based upon their structure and reproduction, and the broadening of this into interest in their functions, their health, their diseases, and even their mutual relations in plant societies, interest in the plant as a living thing has naturally developed.

In all of the modern phases of botany the tendency now is to look upon the plant as a living organism with work of its own to perform its own problems of existence to solve. In the very early stages of this interest it seemed to many persons that the mere statement that the plant was a living thing was a sufficient explanation of the phenomena shown in its activities. Perhaps this may still seem so to some.

The search for a "vital principle"[2] at first based on observation and speculation, but later professing to find some basis of support in the facts of modern experimental biology has proved unsatisfactory as not contributing to progress. Whether it is the "entelechy" of Driesch or the "x-entity" of Ganong it offers only slight help in getting anywhere. Neither the vitalist nor the neovitalist offers us a program for work.

During the years immediately preceding 1900 the tendency to postulate some sort of material particle as the ultimate basis of life was dominant. These particles or corpuscles were supposed to consist of more than one molecule and it was from them that the organism was built up in one way or another. They were also supposed to be the bearers of heredity.

In botany corpuscular theories resulted largely in research, the basic idea of which was that the chromosomes produced in the nucleus at the time of cell division are the bearers of heredity. Since these bodies are

[2] *Cf.* Child, Senescence and Rejuvenescence," Chap. 1.

plainly visible in a dividing cell under the microscope, attention was naturally focused upon them. However, even if any one succeeded in connecting up the transmission of some particular character to the offspring with some peculiar form of one of the chromosomes we still had the question of why that particular form was connected with that particular character. Thus little was accomplished so far as the fundamental problem was concerned. Although much knowledge was gained by investigations of this sort, they still furnished no means of direct attack upon the fundamental problem.

Investigations of the sort just mentioned illustrate the first fundamental defect of all corpuscular theories, considered as a means of advancing our knowledge of biology, viz., the corpuscles are hypothetical and thus merely serve to put biological problems beyond the reach of scientific investigation.

A second defect of corpuscular theories is that they provide no adequate mechanism for the correlation of the various organs making up a complex organism. Means of securing dominance of one part and subordination of another are lacking.

With the advance of knowledge of physics and chemistry and the growing interest in experimental plant physiology, the point of view in regard to plant functions shifted and we were chiefly concerned for a time with what may be called the chemical point of view in considering the phenomena involved in the activities of living organisms. It is of course, evident that chemical reactions play a large part in the life processes. It is also well known that life is closely associated with the substance which we call proteins. This gave rise to the idea that certain complex protein molecules are the "producers of life."

Though the molecule itself according to this conception is not alive, its constitution is the basis of life and life results from the chemical transformations which its lability makes possible. The living substance, then, says the explanation of life, is a substance in which some of the labile molecules are continually undergoing transformation. Life itself would then consist in chemical change, not merely in chemical constitution. Death must then be regarded as a change from lability to stability. The dead proteins, which the chemist might analyze could not of course, show the properties of the living substance, and the fundamental problems of life were thus again placed outside the realm of experimental science.

About 1900 questions began to be heard as to the existence of a "living substance" of more or less definite chemical structure. We are indebted largely to Höber's book published in 1911 for crystallizing our ideas as to the hopelessness of the purely chemical point of view and pointing the way to the physico-chemical, for starting us away from the idea that protoplasm is merely a complex chemical substance, toward the conception of protoplasm as composed of many chemical substances existing as a complex physical system. This assuming a colloid substratum for the organism, is the physico-chemical theory of life which represents the prevailing point of view in the biology of to-day.

This leads us to look upon the plant as a living physical system, receiving energy from its environment and doing work that is more or less useful to itself and to mankind. It points the way to a definite program for work and is then a source of gratification to the modern experimental botanist.

"The situation at present," says Dr. Briggs,[3] "may perhaps be fairly summar-

[3] *Jour. Wash. Acad. Sci.*, 7: 89, 1917.

ized as follows: The mechanism of plant processes not at present explainable on a physico-chemical basis would be termed by the vitalistic school as 'vital,' by the physico-chemical school 'unknown.'" This well expresses the current thought of experimental biologists.

When we have once recognized our ignorrance and have found a means of learning, the situation looks more hopeful. Having arrived at this physico-chemical conception of the organization and activities of the living plant, the energy point of view furnishes the best means now available of making the experimental attack on the nature of the processes involved in plant metabolism. Change in the physical system must always be conditioned by the energy available. Since we look upon the living plant as a physical system we must be concerned with its energy transformations. We have until very recently considered the activities of the plant largely from the view point of the materials received by it from the outer world and the products formed from these materials. Now we are turning our attention toward the question of what forms of energy the plant may be able to use in these various transformations, or rather, we are broadening our vision to include both the materials and the energy.

In our consideration of the energy relations of plants we are largely concerned with four questions: (1) From what sources does the plant receive its energy? (2) What work does it accomplish by means of the energy received? (3) How effectively does it use this energy? (4) In what classes of plant problems does the energy point of view suggest a hopeful means of attack in research.

Under certain conditions the plant may absorb heat from the surrounding air. It also commonly takes in from the soil solution and perhaps even from the air certain energy containing compounds. Still the plant receives much of its energy directly from the sun in the form of light rays. What we know of its reception and use by the plant is largely confined to that portion lying within the visible spectrum, though some scientific excursions have been made into the realms of the ultra-violet and the infra-red rays.

The leaf is the most useful portion of the plant for receiving and utilizing this radiant energy of the sun. Being by nature a surface-exposing organ, the leaf brings its green cells into such a situation that they advantageously receive light energy from the sun's rays.

It is in the green cells of the leaf that those transformations of energy take place, which are most significant to the plant in its own problems of existence as well as to man in his.

The radiant energy falling upon the leaf of the plant may be disposed of in several ways. Some of it is reflected from the leaf surface and is then lost so far as its immediate effect upon the plant is concerned. This is a very small amount, but still it can not be entirely neglected.

Some of the sun's energy passes entirely through the leaf and is then also lost. Direct measurements of both the intensity and the wave-length of the light thus passing through the leaf have been made. Some of the energy retained by the leaf is used in evaporating water from the surface of the leaf. This is a much larger amount than both of the preceding combined. The amount of water thus evaporated from the aerial portion of a plant is large relative to the weight of the plant itself. Grass plants often give off in the form of vapor in every twenty-four hours of dry hot summer weather, a quantity of water equal to their own weight. The grass of an ordinary city lot 50 × 125 feet would give off

under these conditions about 125 gallons of water in every twenty-four hours. If this is raised an average of 1 foot, it means the expenditure of 1,100 foot pounds of energy per day through the medium of the grass on the city lot.

A birch tree standing in the open has been found to give off over 800 pounds of water per day. A man equipped with two ordinary water pails would have to make thirty-two trips in order to carry this amount of water. If he had steps up to the top of the tree and could make a round trip very ten minutes he would work over five hours per day to carry this amount of water.

This evaporation is a large factor in raising water to the tops of plants. Recent investigation indicates that this molecular diffusion which we call transpiration exerts suction throughout the whole vascular system of the plant—leaves, branches, stem and roots. The contained water seems to be under tension even to the tips of the roots.

Transpiration operates through osmosis in leaf cells and through the tensile strength of the water column in the conductive tubes of the plant to accomplish this. While the actual vaporization of this water is dependent solely upon the evaporation power of the air (*i. e.*, temperature and relative humidity of the air actually in contact with the leaf cells) it is very probable that other forces arising from the presence of energy containing compounds in the plant are largely responsible for placing this water on the surface of the cells where the evaporating power of the air can act.

I have now mentioned two ways in which the plant allows radiant energy to escape without making use of it, and one way in which it uses it. The fourth possible fate for this energy is in food synthesis by the plant. A very large amount of the radiant energy received by the leaf is used in making compounds of high energy content from compounds of low energy content. The basic process in this group of synthesis is the manufacture of sugar and starch from carbon dioxide and water. This process depends upon the catalytic action of chlorophyll, the green coloring matter of plants.

This is a reduction process resulting in the storing of energy in such a form that it may be released by oxidations, such as occur in respiration, for the use of the plant. If not thus freed for the direct use of the plant this energy may remain stored in the form of coal or of hydrocarbon oils, and even ages after its capture by the plant may furnish heat for our homes or power to drive our railway trains or autos. More immediately it furnishes us through our food, all of which comes directly or indirectly from plants, the energy to perform work with our hands and our brains. The activities of the world are based on photosynthesis—the reduction of carbon dioxide by the plant resulting in the formation of carbohydrates.

This series of syntheses started in the formation of carbohydrates by the plant is important in the more direct production of mechanical energy, as well as in the matters just discussed. It is perhaps looking far into the future to consider a time when the world's supply of coal and of hydrocarbon oils may be exhausted, but such a time may come. If we keep up our present rate of stripping the earth of its clothing of forest trees, the supply of wood will not last forever and a constantly increasing portion of it will be necessary for structural purposes. The situation tends to turn our attention toward those sources of energy, which are not destroyed in the using and those that are capable of renewal within a brief time by growing plants.

The utilization of water falls and the employment of solar engines come under the first head. Here in the West we are utilizing, in electrical form, a considerable amount of energy from water falls and rapids, and have only just begun on the development of the possible power sites of the region. While many other localities can develop considerable amounts of energy in this way, not all portions of the earth are so well favored. Solar engines are reported to be in successful operation in a few places where the total annual amount of sunshine is unusual. Even with the full use of hydroelectric power and of solar engines, the situation, while not appearing serious for the immediate future, is such as to cause us to look with interest at the possibility of alcohol and other plant products as a source of energy.

In addition to the uses above mentioned for this energy, it may also function in other processes going on within the plant and necessary for its life and growth, and thus for its continuing to function in making possible the existence of human life on the earth. The intake of water by the plant from the soil solution seems to be mainly through the process of osmosis, although there seems to be much reason now for believing that we have been placing entirely too low an estimate on the part played by imbibition. In either case, the energy for the intake of the enormous quantities of water evaporated from the plant as well as the considerable amount used in the synthesis of food substance resides in the substances elaborated by the plant from the raw materials taken in from air and from soil solution.

Osmosis and imbibition are processes whose energy is largely traceable ultimately to the photosynthetic activity of the plant itself or of other plants either recently or in the remote past. Among the important results of this intake of water is the maintenance of form in the softer parts of plants, due to the fact that their cells are so full of water as to be turgid. Everyone is familiar with the loss of form by the leaves and young stems in wilting, *i. e.*, a loss of the turgidity of its cells.

Considerable amounts of work are done by plants in their mechanical effect on obstacles that come in the way of their growth. Striking evidence of this was seen on the campus in the spring of 1910 where the large ferns buried under the asphalt put down on the campus roadway during the preparation for the exposition of 1909, burst through these roadways at numerous points and continued healthy growth until trodden down by the increasing number of students and faculty of the university. By the further expenditure of energy the plant increases the extent of its own tissue by cell division and by the thickness of the walls of these cells, resulting in rigid tissue which are the main factor in the mechanical strength of older woody portions of plants. This energy comes to the aid of man in supplying wood and coal for fuel and for the various uses which wood finds in the structures incident to modern civilization.

There are other minor uses for the radiant energy received by the plant from the sun. Under certain conditions a limited amount of it may go to keep up the temperature of the leaf to that of the surrounding air. A certain amount of the sun's energy finds its use in the locomotion of the adult form of a few lower plants and of minute reproductive bodies in many higher plants. A small amount through oxidation results in the production of luminosity in a limited number of plants.

The plant uses this energy inefficiently. The potential energy stored up in the plant, as measured by determining the heat of combustion, is only 1 per cent. to 5 per

cent. of the total energy received from the sun. Thus 95 per cent. to 99 per cent. of the energy received is dissipated by the plant.

The energy point of view has helped greatly in clarifying our methods of thinking on biological problems. As a result we are now experimenting along lines that give great hope for future success.

Luminosity in plants was for a long time an intangible will-o-the-wisp—a foundation for belief in ghosts. It was not until it was studied as an oxidation that the facts were established and the mystery cleaned up.

Our study of the intake of water by plants from the soil solution has in the past consisted too much in the substitution of the word "osmosis," for any clear notion of the nature of the processes that really take place. A good deal of thought unfortunately not so far resulting in much experimentation is now being directed toward the nature of the energy involved in the two processes for which we use the names "osmosis" and "imbibition."

Considerable more thought and experimentation have gone into attempts to understand the kinds and magnitude of the energy involved in the raising of water to the tops of plants. The chief progress in this field during recent years has been the result of thinking in terms of energy.

Among the many important economic contributions made by botanists during the last few years, a piece of work by Briggs and Shantz[4] on crop plants for arid regions well illustrates the usefulness of thought along energy lines. Plants that flourish without irrigation in these arid regions must, of course, be able to get along with very little water. They found that the efficiency with which these plants use radiant energy is inversely proportional to their water requirement. Hence, instead of introducing from more humid regions the plants of high water requirement and trying to supply to their roots all of the water that they can use, a more profitable line of endeavor seems to be that of the reduction of the water requirement of varieties of crop plants that are to be grown in these regions. There are two lines of endeavor that seem hopeful in this—the selection of varieties having low water requirements and the lowering of the evaporation rate by artificial means, thus lowering the water requirement of the plant.

The field of photosynthesis is an extremely important one for the use of the energy point of view. All of the probable steps in the synthesis of carbohydrate from inorganic nature have now been repeated in the laboratory. In the main, however, this has been accomplished by employing forms of energy probably not available in the plant. The search for the energy that may be available for this synthesis should engage much of the attention that is now going merely to a consideration of the materials involved.

Some confusion on the energy involved in the process has resulted in the past from the fact that a few of the earlier workers had differences in intensity when they thought they had only differences in wave length. However, clearer thinking and better apparatus are already pointing to definite progress in this field. The photoelectric cell has already been employed in plant physiology as a means of measuring the light intensity under which the plant is carrying on its life processes and important data will undoubtedly be obtained through its use by future investigators.

The energy point of view has already helped greatly in our understanding of carbohydrate synthesis in plants and promises still more in the future for progress in

[4] *J. Agr. Res.*, 3: 1–63, 1914.

our understanding of this process so fundamental to our well being and happiness and even to existence itself. The energy point of view is the keynote of modern investigations in plant physiology.

This method of thinking is proving beneficial not only in those biological problems upon which direct experimentation is possible but also in giving clearer notions of some processes that have taken place in the past and appear to be at the present time outside the realm of possible experimentation.

Thought as to the possible steps involved in the early stages of organic evolution furnishes a good example of this. We are now getting away from a consideration of merely the form of the possible organisms which represented the first stages in the evolution of higher plants and animals and are now considering what forms of energy they could have utilized. Since we can hardly suppose that the first step from the non living to the living involved the presence of chlorophyll we think about them in terms of the possible forms of energy that they could have found available. Progress is being made by this kind of thinking. The suggestion that it at present offers is that sulphur and iron bacteria being able to oxidize inorganic compounds and being thus free from the necessity of the presence of chlorophyll on the earth, probably represent very early stages in organic evolution.

The usefulness of the energy point of view is thus apparent. It is not profitable to think longer in terms of vital force, of corpuscular responsibility for inheritance, nor alone in terms of the chemical compounds involved. We think rather of the energy transformations as related to both physical and chemical conditions. Does it not seem evident that the line of future progress in many fields of botanical investigation will be largely along the paths seen from the view point of energy transformations in the plant?

George B. Rigg

Seattle, Wash.

EDUCATIONAL EVENTS

THE DEATH OF THORILD WULFF

A letter from Peter Freuchen, the Danish factor at Knud Rasmussen's Station at North Star Bay, Northwest Greenland, written in late February, gives a direct and definite account of the death of Dr. Thorild Wulff, Swedish botanist and ethnologist, who accompanied Knud Rasmussen on his recent trip to Peary Land and return across the Greenland ice-cap. Translated from the Danish, part of the letter is as follows:

The party, composed of Knud Rasmussen, leader; Lauge Koch, geologist and cartographer, and Dr. Thorild Wulff, botanist and ethnologist, left North Star Bay, as you probably know, early in April, 1917. They were accompanied by four Eskimo—Hendrik Olse, Inukitsok ("Harrigan"), Ajago ("Pingasut") and Boatsman.

They traveled without mishap as far as St. George Fjord, where difficulties began—no game at all, with the exception of a few hares and a seal or two; scarcely a trace of muskoxen. Hence they could go no farther than De Long's Fjord. Here they started homeward, exhausted, and much depressed by the loss of Hendrik, who was devoured by wolves while out hunting. Weak from lack of food, he had apparently lain down to sleep, and before he could defend himself, the wolves had overcome him.

The others talk of the return journey over the ice-cap as a bad dream. After incredible difficulties, they finally attained the west coast at Cape Agassiz near the Humboldt Glacier, just a short time after they had eaten their last dog.

Knud Rasmussen and Ajago at once started on a forced march to Etah to get aid. The others were to rest a little, and then follow slowly after, trying to kill enough game to sustain them. After a few days slow travel without any food, Dr. Wulff could go no farther, and laid himself down to die. He wrote messages to his children and his parents, and dictated to Koch a brief survey of the vegetation about Peabody Bay, for he had continued his observations to the last. He was so weak and ex-

hausted that he knew he could not last much longer.

Forced to abandon him if they were to survive, Koch, Inukitsok and Boatsman went slowly, on farther. Just as they were about to give up entirely, they killed two caribou that kept them alive until relief came from Etah.

Later in the fall, I went up to bury Dr. Wulff, but I could not find his body because of the darkness.

Dr. Wulff has done a very fine piece of work, both botanical and zoological, along the whole coast that he traversed. Koch has also done good work. He succeeded in mapping accurately the whole coast along which the party traveled, including several hitherto unknown fjords. He found the former maps inaccurate in many places. He has moreover brought back a few Silurian and Cambrian fossils from far north.

Koch is not yet (February 23, 1918) quite well, but now that we have brought him to Upernivik and the care of Dr. Bryder and the other good people here, he is fast regaining his strength and health.

This excerpt narrates without embellishment one more of the incidents that make the annals of the North so full of tragedy. The name of Dr. Thorild Wulff is one more added to the long list of heroes lost in Arctic service. Sweden may well be proud to claim him.

W. Elmer Ekblaw

University of Illinois

RETIREMENT OF DEAN EDWARD H. BRADFORD OF THE HARVARD MEDICAL SCHOOL

After thirty-eight years of service on the faculty of the Harvard Medical School, Dr. Edward H. Bradford, has tendered his resignation to take effect on September 1. At the Commencement exercises President Lowell announced a gift of $25,000 from an anonymous source to found the Edward Hickling Bradford fellowship, which is to be used for research or instruction separately or in connection with any other foundation at the Harvard Medical School in such manner as the Harvard Corporation may from time to time prescribe. Dr. Frederick C. Shattuck, Jackson professor of clinical medicine emeritus, pays the following tribute to Dean Bradford in the current issue of the Harvard Alumni Bulletin:

It were unpardonable, even in these stressful days, to allow the resignation of Dr. Bradford as dean of the faculty of medicine to pass unnoticed.

Six years ago, just at the time he had freed himself from hospital work, and had also resigned the professorship of orthopedic surgery of which he was the first incumbent, putting aside the prospect of well-earned leisure and realizing that his private work was likely to suffer, he listened to the call and assumed the deanship. Almost year by year the work of the dean's office has increased with the growth of the medical school, with the expansion and complexity of its activities. It had been his intention not to hold office more than five years; but the exigencies growing out of the war, into which we had just entered, seemed to make it desirable for him to add another year.

Among the developments which have occurred during his tenure of office may be mentioned: the graduate school of medicine so ably headed by Dr. Arnold; the school of tropical medicine under Dr. Strong; the school for health officers under the joint charge of the department of preventive medicine and the Massachusetts Institute of Technology; the further extension of preventive medicine into the fertile field of industrial health and occupational disease, the plans for the opening of which in the coming September are now being laid out; entrance examinations have been revised so as to permit greater elasticity without letting down the bars. A new system of examinations leading to the M.D. degree has been applied.

The Harvard Infantile Paralysis Commission was appointed in September, 1916, following the epidemic of that summer, and is still active. As a member of the committee on education of the American Medical Association Dr. Bradford kept in close touch with nation-wide thought on this subject, and made Harvard influence felt.

It was due to Dr. Bradford's firmness that fourth-year teaching was carried on through the summer of 1917 in Harvard and Columbia, enabling students to graduate in March.

In these and many other matters, Dr. Bradford has taken initiative, or given sympathetic encouragement or guidance. There has been a notable increase in the number of students, both under graduate and graduate in the six years he has been dean. "Well done, good and faithful servant."

THE CHEMICAL WARFARE SERVICE

By order of the Secretary of War General Peyton C. March has issued under date of June 28, the following general orders:

I. 1. Under authority conferred by sections 1, 2, 8 and 9 of the act of Congress "Authorizing the President to increase temporarily the military establishment of the United States," approved May 18, 1917, and the act "Authorizing the President to coordinate or consolidate executive bureaus, agencies and offices, and for other purposes, in the interest of economy and the more efficient concentration of the government," approved May 28, 1918, in pursuance of which act the President has issued an executive order dated June 25, 1918, placing the experiment station at American University under control of the War Department, the President directs that the gas service of the army be organized into a Chemical Warfare Service, National Army, to include:

(*a*) The Chemical Service Section, National Army.

(*b*) All officers and enlisted men of the Ordnance Department and Sanitary Corps of the Medical Department as hereinafter more specifically specified (regular officers affected being detailed and not transferred).

2. The officers for this service will be obtained as provided by the third paragraph of section 1 and by section 9 of the act of May 18, 1917, the enlisted strength being raised and maintained by voluntary enlistment or draft.

3. The rank, pay and allowances of the enlisted men of the Chemical Warfare Service, National Army, shall be the same as now authorized for the corresponding grades in the Corps of Engineers.

4. The head of the Chemical Warfare Service, National Army, shall be known as the Director of the Chemical Warfare Service, and, under the direction of the Secretary of War, as such, he shall be, and hereby is, charged with the duty of operating and maintaining or supervising the operation and maintenance of all plants engaged in the investigation, manufacture, or production of toxic gases, gas-defense appliances, the filling of gas shells, and proving grounds utilized in connection therewith and the necessary research connected with gas warfare, and he shall exercise full, complete and exclusive jurisdiction and control over the manufacture and production of toxic gases, gas defense appliances, including gas-shell filling plants and proving grounds utilized in connection therewith, and all investigation and research work in connection with gas warfare, and to that end he shall forthwith assume control and jurisdiction over all pending government projects having to do or connected with such manufacture, production and operation of plants and proving grounds for the army and heretofore conducted by the Medical Department and Ordnance Department under the jurisdiction of the Surgeon General and the Chief of Ordnance, respectively, and all material on hand for such investigation or research, manufacture or production, operation of plants and proving grounds, and all lands, buildings, factories, warehouses, machinery, tools and appliances, and all other property, real, personal or mixed, heretofore used in, or in connection with, the operation and maintenance of such plants and proving grounds for the purpose of investigation or research, manufacture or production, already procured and now held for such use by, or under the jurisdiction and control of the Medical Department or the Ordnance Department, all books, records, files, and office equipment used by the Medical Department or the Ordnance Department in connection with such investigation or research, manufacture or production, or operation of plants and proving grounds, all rights under contract made by the Medical Department or Ordnance Department in, or in connection with, the operation of such plants and institutions as specified herein, all rights under contract made by the Medical Department or Ordnance Department in, or in connection with such work, and the entire personnel (commissioned, enlisted and civilian) of the Ordnance Department and Sanitary Corps of the Medical Department as at present assigned to or engaged upon work in, or in connection with, such investigation or research, manufacture or production, or operation of plants and proving grounds, are hereby transferred from the jurisdiction of the Ordnance Department and the Medical Department and placed under the jurisdiction of the Director of the Chemical Warfare Service, it being the intention hereof to transfer from the jurisdiction of the Medical Department and the Ordnance Department to the jurisdiction of the Chemical Warfare Service, every function, power and duty connected with the investigation, manufacture, or production of toxic gases, gas-defense appliances, including the necessary research connected with gas warfare, gas-shell filling plants, and proving grounds utilized in connection therewith, all property of every sort or nature used or procured for use in, or in connection with, said operation of such plants and proving grounds and the entire personnel of the Ordnance Department and Sanitary Corps of the Medical Department as at present assigned to, or engaged upon work in, or in connection with, the operation and maintenance of such plants engaged in the investigation, manufacture or production of toxic gases, gas-de-

fense appliances, including gas-filling plants and proving grounds utilized in connection therewith.

5. All unexpended funds of appropriations heretofore made for the Medical Department or Ordnance Department and already allotted for use in connection with the operation and maintenance of plants now engaged in, or under construction for the purpose of engaging in, the investigation, manufacture or production of toxic gases or gas defense appliances, including gas-shell filling plants, are hereby transferred to, and placed under the jurisdiction of the director of the Chemical Warfare Service for the purpose of meeting the obligations and expenditures authorized; and, in so far as such funds have not been already specifically allotted by the Medical Department and the Ordnance Department for the purposes specified herein, they shall now be allotted by the Secretary of War, in such proportions as shall to him seem best intended to meet the requirements of the situation and the intentions of Congress when making said appropriations, and the funds so allotted by the Secretary of War to meet the activities of the Chemical Warfare Service, as heretofore defined herein, are hereby transferred to, and placed under the jurisdiction of, the director of the Chemical Warfare Service for the purpose of meeting the authorized obligations and expenditures of the Chemical Warfare Service.

6. This order shall be and remain in full force and effect during the continuation of the present war and for six months after the determination thereof by proclamation of the treaty of peace, or until theretofore amended, modified or rescinded.

II. By direction of the President, Major General William L. Sibert, United States Army, is relieved from duty as director of the Gas Service, and is detailed as director of the Chemical Warfare Service, National Army.

TRAINING OF COLLEGE STUDENTS FOR MEDICAL CORPS OFFICERS[1]

The Medical Department of the Army, through the National Research Council, will shortly issue an appeal to American colleges and universities urging them to alter their curriculum so that third and fourth year students may receive special training which will enable them to qualify as officers and for other work in the Medical Department.

The appeal will be sent to all the principal colleges and universities in the country, but as it is realized that important institutions may not for various reasons receive the appeal, the request is made that all directing heads of such institutions write to either Dr. Richard M. Pearce, of the National Research Council, Washington, or to the Division of Laboratories, Office of the Surgeon-General, Washington, for details of the proposed plan.

These colleges will render valuable assistance to the government by offering these special course to their students who will enter the Army when they become of age or in the event that they volunteer before that time. The students desired are those who are taking the various scientific courses. The course proposed by the Medical Department should appeal to men who are specializing in biology, zoology, plant pathology, and in industrial and agricultural bacteriology.

In a number of institutions the necessary courses can be arranged by a simple modification of the already existing course in bacteriology with added emphasis on special subjects of value to the Army.

After completing such courses arrangements for enlistment can be made through the Surgeon-General's Office if the applicant is under draft age, and if of draft age he can be inducted into the service and assigned where his special training will be of value.

This plan has already been tested in two colleges and the success attained has led the Medical Department to apply it to as many colleges as possible. From one such institution every man taking the modified course was admitted directly into the Army and went to one of the training schools, where a portion of them will later qualify for commissions in the Sanitary Corps. Others have qualified for positions at field or mobile laboratory units and as assistants in base and evacuation hospitals.

[1] Publication authorized by the War Department from the office of the Surgeon General.

SCIENTIFIC NOTES AND NEWS

Dr. James F. Norris, who has been with the Bureau of Mines Experiment Station, has been commissioned a lieutenant-colonel in the Chemical Service Section of the National Army and is to be stationed in London as the

representative of the Army, in chemical warfare, in England. The following men, all in the Chemical Service Section, are to be with him to help in the work: Captain A. B. Ray, Captain G. M. Rollason, Lieutenant H. A. F. Eaton, and First Sergeants E. O. Hobbs, L. C. Benedict, C. E. Wood and J. A. Bowers.

Captain Laurence Martin, of the geological department of the University of Wisconsin, was commissioned as a major on July 23, and has been detailed for duty with the Federal Staff Corps.

Professor V. H. Wells, of the department of mathematics, of the University of Pittsburgh, has been commissioned a lieutenant in the science and research division of the signal corps.

Dr. S. A. Mitchell, director of the Leander McCormick Observatory of the University of Virginia, is at present in Jersey City engaged as instructor in navigation for the U. S. Shipping Board.

Mr. William J. Hammer, consulting physicist and electrical engineer, of New York, has been commissioned a major in the National Army, and is assigned to duty in Washington with the newly organized Inventions Section of the General Staff.

Professor T. D. Beckwith, head bacteriologist of the Oregon Agricultural College, has been commissioned captain in the Sanitary Corps and is ordered to report at the Rockefeller Institute for Medical Research at New York.

Professor F. B. Sanborn, a member of the Tufts College faculty since 1899 and head of the department of civil engineering since 1901, has resigned to enter business in Boston. His firm is now engaged in important manufacturing work for the government.

Mr. Neil M. Judd, assistant curator of anthropology in the National Museum, has recently returned from explorations of the House Rock valley and the Pahreah and Wahalla plateaus, on the north rim of the Grand Canyon in northern Arizona. Several cliff dwellings and ruins were discovered. Since his return to Washington, Mr. Judd has enlisted in the aviation section of the Signal Corps.

Mr. F. T. Sun, director of a fisheries school at Tientsin, China, established and maintained by the Province of Chihli, is in the United States in order to gather information and material for his school, which is devoted principally to the preparation and utilization of fishery products.

Dr. Hans Moore, director, and Albert Scheret, professor, in the agricultural college near Lucerne, Switzerland, are studying methods of agriculture in the United States.

Professor Joseph S. Ames, director of the physical laboratory in the Johns Hopkins University, recently gave the annual address at the University of Virginia before the Phi Beta Kappa Society. The title of the address was "The Value of the Scientific Man in War."

Miss Stephenson has offered £2,500 to endow a studentship in the faculty of arts at Armstrong College, Newcastle, in memory of her father, the late Sir William Haswell Stephenson.

The name of the Memorial Institute for Infectious Diseases, founded in the memory of John Rockefeller McCormick, has been changed to The John McCormick Institute for Infectious Diseases.

Henry Shaler Williams, emeritus professor of geology at Cornell University, died of pleurisy, on July 31, at Havana, aged seventy-one years. He was born in Ithaca in 1847, graduated from Yale in 1868 and held the professorship of natural science in the University of Kentucky from 1871 to 1872. He was professor of geology in the same university from 1880 to 1892 and Silliman professor at Yale University from 1892 to 1904. His research work in Cuba resulted in the development of oil fields in the island.

Dr. John Duer Irving, professor of economic geology at Yale University, known for his work in ore deposits, has died of pneumonia in France, aged forty-four years. Professor Irving was one of the first from the Yale

faculty to volunteer for service at the outbreak of the war, joining the New York Engineer Corps.

PROFESSOR A. L. DANIELS, Williams professor of mathematics in the University of Vermont, died on July 18, aged sixty-nine years. He was made professor emeritus, on the Carnegie Foundation, in 1914, after a service of twenty-nine years.

DR. E. W. SANFORD, of the Johns Hopkins University faculty, has died in Centerville, Conn., from blood poisoning produced by accidental inoculation while engaged in research work for the government.

DR. LUDWIG EDINGER, director of the Neurologic Institute of Frankfort-on-Main, known for his work in the comparative anatomy of the nervous system, has died at the age of sixty-three years.

THE death is announced of Dr. Régis, professor of mental diseases at Bordeaux.

DR. MIGUEL SANCHEZ-TOLEDO, professor of physiology at the University of Havana, died on July 13.

GIFTS to the Brooklyn Institute of Arts and Sciences amounting to $70,000 were reported at the June meeting of the board of trustees. Of this amount $60,000 was given by Mr. Samuel P. Avery for the endowment of the Institute's department of education, and $10,000 by two unnamed donors for the endowment of the Brooklyn Botanic Garden, a division of the institute. The terms of the Botanic Garden gift stipulate that it shall be known permanently as the "Benjamin Stuart Gager Fund," in memory of Director Gager's little son who died last spring.

THE Bureau of Oil Conservation, Oil Division, U. S. Fuel Administration, is desirous of securing a combustion engineer for each of the following districts, who will act as an inspector visiting all plants within his district using fuel oil and natural gas: Boston, Providence, New York City, Philadelphia, Pittsburgh, Buffalo, Detroit, Chicago, Minneapolis, Tulsa, New Orleans and San Francisco. It is desirable that these men should act as volunteers where possible, but the Administration is prepared to pay a reasonable compensation for men who can not afford to give their services to the government. Only men who have had experience in fuel oil and natural gas combustion would be of value.

AN editorial note in *Nature* asks: "Is the Carnegie Trust for the Universities of Scotland doing its duty in strengthening and developing scientific study and research? That is the question suggested by the report of a special committee published in the December number of the Journal of the British Science Guild. The question was first raised in an incisive manner by Professor Soddy in an article communicated to *Science Progress* (January, 1917), and further inquiry seems to show that his contention is well founded. There may be some difference of opinion as to the exact interpretation of Clause A of the Trust Constitution; but there can be no doubt that the main object of the trust is to foster science, pure and applied, in all its branches, and to strengthen that side of university education which is of direct technical or commercial value. In the light of that general principle the following facts are well worthy of careful consideration: (1) Only 14 per cent. of the available funds have been expended on scientific research; (2) by endowment out of Carnegie Funds of certain scientific departments, money formerly spent in their maintenance has been diverted into other channls, so that the university on its scientific side has not really been strengthened; (3) among the twenty-two members of the board of trustees, there have never been more, and have usually been fewer, than four who could be regarded as representing science, the majority being practically ignorant of the methods, and even the meaning, of research."

UNIVERSITY AND EDUCATIONAL NEWS

THE University of London has received a bequest of £2,000 for the engineering faculty of King's College under the will of Lieutenant R. C. Hodson, a former student in the enginering department of the college, who was

killed in France last year, and a donation of £51 from Miss Gertrude Jones for the purposes of the Galton Laboratory at University College.

President J. G. Schurman, of Cornell University, has received leave of absence from the university until next October and will devote the summer to patriotic work in France. During his absence, Professor Dexter S. Kimball, acting dean of Sibley College, is, by appointment of the board of trustees, acting president of the university.

At the University of Minnesota Professor H. H. Kildee has resigned as professor and chief of the dairy husbandry division in order to become head of the department of animal industry at the State College of Iowa at Ames; G. E. Weaver and H. R. Searles have resigned as assistant professor and intructor, respectively, of dairy husbandry to enter government service with the marines; Miss Josephine T. Berry has resigned as professor of nutrition and chief of the Division of Home Economics in order to continue her work as assistant director for home economics of the Federal Board for Vocational Education; Miss Mildred Weigley who has been associate professor and acting chief during Miss Berry's leave of absence has been promoted to the position made vacant by Miss Berry's resignation. I. D. Charlton has resigned as professor and chief of the Division of Farm Engineering in order to enter war service; J. S. Montgomery has resigned his position as associate professor of animal husbandry in charge of the section of horse husbandry in order to accept a position with a large stock breeder.

Mr. A. M. Chickering, instructor in biology in Beloit College for several years, has been elected to the professorship of biology in Albion College and will assume his new duties with the opening of college in September.

Miss Alice M. Boring has resigned as associate professor of zoology at the University of Maine and received an appointment in the premedical department of the Peking Union Medical College, China.

Dr. Seth Lake Strong, who was graduated from the Harvard Medical School in the class of 1913, has been appointed lecturer in surgery to the Royal Medical College at Bangkok, Siam, and will also act as surgeon to the Siravaj Hospital there.

Captain M. J. Stewart has been elected professor of pathology and bacteriology in the University of Leeds. He received his commission in 1915 and has served as pathologist to the East Leeds War Hospital, and in a similar capacity in France. A few months ago he was recalled to Leeds and undertook the acting headship of the department of pathology and bacteriology.

The following appointments are announced in the geological sciences in Germany and Austria: Professor W. Branca has retired from his professorship in Berlin, and has been succeeded by Professor J. Pompecki, of Tübingen. Professor E. Kayser has similarly retired in Marburg, and his successor is Professor R. Wedekind. Professor L. Milch, of Greifswald, has followed the late Professor Hintze as professor of mineralogy in Breslau, and Professor E. Hennig, of Berlin, has become professor of geology at Tübingen. Professor O. Abel has been made professor of paleobiology in Vienna.

DISCUSSION AND CORRESPONDENCE

FORMATIVE SETTING OF LACCOLITHIC MOUNTAINS

Although the simple "Blister" hypothesis of laccolithic intrusion, which was for the first time proposed for the Henry Mountains in southern Utah, finds so few supporters, of late little is done towards arriving at a better solution. Perusal of the descriptions of the Henry Mountains soon discloses the fact that not all of their story is yet told. There is nowhere any suggestion of relationships possibly existing between the local tectonics and the intrusive structures. Without these the phenomenon seems, as has been so often urged, a mechanical impossibility. This is the view which most Europeans take. In consequence they frequently confound laccolithic structure with that presented by denuded volcanic necks.

A number of facts militates strongly against the Henry Mountains explanation of loccolithic protuberance. Three basic premises appear wholly untenable. Most vitiating is the seeming incompetency of simple hydrostatic pressure to produce the desired results. Inadequacy of relative lithologic density is now commonly conceded. There also appears to be a radical disparity between the physical conditions accompanying the formation of laccoliths and their once supposed nearest kin the sills.

On the other hand the recent unearthing of the infrabasal make-up of certain laccoliths clearly points to a fundamental dependence of this class of mountains upon prior geologic structure. The shape of laccolithic masses is found to be cuneiform instead of lenticular; and thus at once does away with the blister idea. Quite essential appears to be the presence of crustal lines of weakness. The magmatic swelling or localization of laccoliths is discovered to be a direct function of orographic potentialities.

In seeking an immediate cause for his laccolithic intrusion Professor Gilbert did not lose sight of certain mechanical shortcomings of his explanation. These he sought to overcome by appealing to certain associated factors, which, however, later, Doctor Cross showed to be both unnecessary and not demonstrated as such. Professor J. D. Dana got over the difficulties by brushing aside all considerations except simple hydrostatic pressure and with this feature alone regarded the Gilbertian hypothesis complete. This is doubtless one of the main reasons why from a mechanical angle leading European geologists have so persistently challenged the American view of laccolithic intrusion. At the same time Old World writers on the theme offer no alternative theory to take the place of the one which they seek to discredit. Through the results of close inspection of certain laccoliths of northern New Mexico the chief objections which were raised against the Gilbert view seem to be fully met. Controlling tectonic factors which all describers of laccoliths have missed thus appear to supply the long sought desiderata.

As a primary consideration in order that a laccolith be produced rather than any other form of volcanic manifestation it appears that the intrusive mass shall have a particular tectonic setting. Profound faulting is one of these prime factors. Another is orographic flexing by which the rigidity of certain arching strata largely maintains the load of superincumbent materials. Probably the high viscosity of acidic magmas has an important but as yet uncalculated influence on events. The remarkable infrabasal structure which the New Mexico laccoliths reveal carries the inquiry a step more remote and explains the deep-seated cause of the major faulting, whereby an orographic prism is sustained by a sharp Pre-Cambrian arch, the rigidity of which is not even yet lost although the adjoining blocks on either side are allowed to slide down, as it were, the steep sides of the old flexure.

Now at the southern terminus of the Rocky Mountain Cordillera, in northern New Mexico, there is a succession of open flexures, the amplitude of which grows less as they recede from the main axis. It is where these folds cross great fault lines that laccoliths form. Thus through direct mathematical analysis of the tectonic problems presented and in the satisfaction of the most urgent tectonic demands an adequate *raison d'être* for laccolithic genesis and location seems to be offered.

Charles Keyes

SOIL REACTION AND THE PRESENCE OF AZOTOBACTER

During the summer of 1917 the writer conducted a preliminary survey of local soils to ascertain the relative nitrogen-fixing ability and prevalence of *Azotobacter*. Ninety soils were collected within two miles of the laboratory. The samples were taken from as widely varying soil conditions as could be located including the following: cultivated, permanent alfalfa, bluegrass sod, native pasture, barren hilltops, river bottom, sand bar, roadside and forest.

When cultured in a standard alkaline mannite solution 41 per cent. of the soils failed to show any *Azotobacter* growth. The average nitrogen fixed, per 100 c.c. cultural solution, in such cultures was 7.76 mg. The average nitrogen fixed in cultures showing *Azotobacter* was 16.22 mg. per 100 c.c. cultural solution.

A study of the reaction of these soils gave very interesting results. The hydrogen ion concentration of an aqueous extract of the soils was measured by the colorimetric method outlined by Clark and Lubs.[1]

The range of hydrogen ion concentration in the soil extracts, prepared by shaking one part of soil with one part of water and centrifuging expressed in P_H was from 5.3 to 7.8. All of the extracts from soils which developed *Azotobacter,* with the exception of three, gave a P_H of 6.0 or above. All of those which failed to give *Azotobacter,* with the exception of three, gave a P_H of 5.9 or less. These results would indicate that the absolute reaction is probably the major factor controlling the presence of *Azotobacter* in soils.

P. L. Gainey
Research Laboratory in Soil Bacteriology,
Kansas Agricultural Exper. Sta.

[1] *Journal of Bacteriology,* Vol. 2, Nos. 1, 2 and 3.

DESIGNATION OF SPECIALIZING PHYSICISTS

Physicists specializing along certain definite lines in such a way or to such a degree that the broad term physicist is not sufficiently descriptive of their professional activities, are frequently at a loss for a suitable designation. For example, a physicist engaged in industrial physics along the lines of electricity may not consider himself an electrical engineer, and still less an "electrician" in the ordinarily accepted use of the term. What shall he call himself? A physicist specializing in mechanics may be neither a mechanical engineer nor a mechanic or mechanician. Similarly one specializing in heat may not be a heating engineer, and one in light may be no optician. The specialist in sound who is now coming into recognition more and more has not even the restricted range of choice given to the others cited.

The answer proposed to the above problem involves a new set of designations of the main subdivisions of the broad science of physics, designations obvious enough in themselves, which commend themselves as logical and acceptable from a terminological standpoint, quite apart from the solution thereby offered of the question raised in the foregoing. It will be noted that the terms being derived from the classic Greek, are international. The following table will make the matter clear.

The Science of	Proposed Designation	Designation of Specialist
Mechanics	Mechanology	Mechanologist
Sound	Phonology	Phonologist
Heat	Thermology	Thermologist
Light	Photology	Photologist
Electricity	Electrology	Electrologist
Magnetics	Magnetology	Magnetologist
Radiation	Radiology	Radiologist

A suggested sample definition is as follows: A mechanologist is a person who is versed in the science of mechanics, or mechanology, and who may, in addition, be skilled in applying the science.

The terms proposed are so obvious that there is no need to make an extended argument in favor of their adoption. The proposals are made with the thought that the need for such terms will become more and more evident through the increased entrance of physics and physicists into industrial and practical work, and it is well that a suitable terminology should be ready at hand for adoption as required.

Clayton H. Sharp
Electrical Testing Laboratories,
New York City,
April 24, 1918

SCIENTIFIC BOOKS

The Science and Practice of Photography. By John R. Roebuck. New York, D. Appleton and Company. 1918. Pp. VIII + 298. $2.00.

In this book Dr. Roebuck publishes the course in photography which has been given under his direction at the University of Wisconsin.

In the teaching of photography to students the tendency has been to lay great emphasis on the chemistry of the subject while the physics of photography, which is at least as important as the chemistry, has too often been ignored. Dr. Roebuck has approached the subject from the standpoint of the physicist rather than from that of the chemist, with the result that in this book there is given a clear and valuable exposition of the elementary principles of sensitometry, that is, of the properties of photographic material and its behavior during exposure and development.

The chemistry of the book is distinctly weak, there is practically no discussion of the chemistry of development, and the few equations given for the action of developers are very much open to question. There are also a few obvious errors in chemistry such as the statement that Stas was a German, or that hydrochloric acid can be added to silver nitrate in order to produce an acid emulsion.

In the portion of the book dealing with general theory the author commences with a brief chapter on the historical development of the subject and then deals with the sensitometry of the gelatine dry plate. A short chapter then discusses the subject of color sensitiveness, and another, theories of the latent image. Further chapters deal with negative defects, a very practical chapter indeed, positive processes, lenses, color photography, and the general principles of composition.

The second part of the book consists of a laboratory manual containing a series of experiments to be performed by the student. This will be very valuable to any teacher arranging a course in photography and a student who has worked thoroughly through the course, repeating the more elementary portions several times, will have had a good training in the elements of the subject.

On the whole the book forms a valuable addition to the scanty list of modern works on photography and is to be recommended to all those who are interested in the scientific side of the subject.

C. E. K. Mees

Rochester, N. Y.

THE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

The first number of Volume 4 of the *Proceedings of the National Academy of Sciences* contains the following articles:

The Basal Katabolism of Cattle and Other Species: Henry P. Armsby, J. August Fries and Winfred W. Braman, Institute of Animal Nutrition, the Pennsylvania State College. The results show that the basal katabolism of different species is substantially proportional to their body surface.

The Location of the Sun's Magnetic Axis: F. H. Seares, A. van Maanen and F. Ellerman, Mount Wilson Solar Observatory, Carnegie Institution of Washington. In extension of the work of George E. Hale, a large number of observations were undertaken to determine the position of the sun's magnetic axis, which is found to lie near the axis of rotation at an inclination of about 6°, and to revolve about the axis of rotation in about 32 days.

Resonance and Ionization Potentials for Electrons in Cadmium, Zinc and Potassium Vapors: John T. Tate and Paul D. Foote, University of Minnesota and Bureau of Standards. The results agree within the limits of experimental error with the values as calculated from the quantum relation $h\nu = eV$, where ν is the frequency of the single radiation in the case of resonance potentials or the limiting frequency of the series of radiations in the case of ionization potentials.

The Validity of the Equation $P = dv/dT$ in Thermo-Electricity: Edwin H. Hall, Jefferson Physical Laboratory, Harvard University. The equation is known to be unverified experimentally. The author gives a brief, critical discussion of the validity of some theoretical proofs by which the equation has been deduced.

On the Equations of the Rectangular Interferometer: Carl Barus, Department of Physics, Brown University. A discussion under the under the headings of: Auxiliary Mirror, Rotating Doublet, Ocular Micrometer, Collimator Micrometer.

The Brain Weight in Relation to the Body Length and also the Partition of Non-Protein Nitrogen, in the Brain of the Gray Snapper (Neomænis Griseus): Shinkishi Hatai, Tortugas Laboratory, Carnegie Institute of Washington and The Wistar Institute of Anatomy and Biology.

The Rotation and Radial Velocity of the Central Part of the Andromeda Nebula: F. G. Pease, Mount Wilson Solar Observatory, Carnegie Institution of Washington. The radical velocity —316 km. is found. The change of rotation velocity with distance from the center seems to be linear.

The second number of Volume 4 contains the following articles:

The Heat Capacity of Electro-Positive Metals and the Thermal Energy of Free Electrons: Gilbert N. Lewis, E. D. Eastman and W. H. Rodebush, Chemical Laboratory, University of California. The experiments go to indicate that in the metals considered the difference between the heat capacity observed and that calculated may be regarded as representing the actual heat capacity of the more loosely bound electrons in these metals.

Thermo-Electric Diagrams on the P-V-Plane: Edwin H. Hall, Jefferson Physical Laboratory, Harvard University. An analysis of the electro-motive force of a thermoelectric circuit on the assumption that the "free" electrons within the metals are the only ones moving progressively in the maintenance of a current, and the only ones taking part in thermo-electric action.

A Determination of the Solar Motion and the Stream Motion Based on Radial Velocities and Absolute Magnitudes: Gustaf Stromberg, Mount Wilson Solar Observatory, Carnegie Institution of Washington. The stream motion is probably a local effect caused by a preferential motion of the stars in both directions around the center of the stellar system. There appears to be a tendency towards smaller values of the declination of the sun's apex for the intrinsically faint stars.

Disease Resistance in Cabbage: L. R. Jones, College of Agriculture, University of Wisconsin. In every case the selected head strains transmitted in considerable degree their resistant qualities, and certain of them did so in high degree. A discussion of the results in their general significance is also given.

Is a Moving Star Retarded by the Reaction of its Own Radiation? Leigh Page, Sloane Physical Laboratory, Yale University. An extended analysis of the forces acting upon the electron leads to the conclusion that the moving electron, and hence any moving matter, suffers no retardation through its motion.

On Electromagnetic Induction and Relative Motion: II. S. J. Barnett, Department of Physics, Ohio State University. The experiments appear to support the hypothesis for the existence of the ether, and to be inconsistent with the principle of relativity.

National Research Council: Report of the Committee on Anthropology.

Notice of Biographical Memoirs: John Shaw Billings; By S. Weir Mitchell and Fielding H. Garrison.

The third number of Volume 4 contains the following articles:

The Effect of Artificial Selection on Bristle Number in Drosophila Ampelophila and its Interpretations: Fernandus Payne, Zoological Laboratory, Indiana University. There are, at least, two factors for extra bristle number, one of them located in the first, and one in the third chromosome.

The Reactions of the Melanophores of Amiurus to Light and to Adrenalin: A. W. L. Bray, Zoological Laboratory, Museum of Comparative Zoology, Harvard College. The melanophores in the skin of the *Amiurus* react to direct stimulation by adrenalin, and are subject to nervous control mediated through the eye.

Further Experiments on the Sex of Parthenogenetic Frogs: Jacques Loeb, Rockefeller Institute for Medical Research. The frogs produced by artificial parthenogenesis can develop into adults of full size and entirely normal character.

The Resolving Powers of X-Ray Spectrometers and the Tungsten X-Ray Spectrum: Elmer Dershem, Department of Physics, University of Illinois. The theory of resolving power is given with the results of experiments on tungsten, in which the endeavor was made to obtain as high a resolving power as possible.

Note on Methods of Observing Potential Differences Induced by the Earth's Magnetic Field in an Insulated Moving Wire: Carl Barus and Maxwell Barus, Department of Physics, Brown University. A simple apparatus is described, and an elementary estimate first given. The apparatus was then modified, producing intensification, and new observations were made.

Dependence of the Spectral Relation of Double Stars upon Distance: C. D. Perrine, Observatorio Nacional Argentino, Cordoba. There is an indication that some external cause is operating in more or less definite regions of our stellar system upon the conditions which produce spectral class.

Hypothesis to Account for the Spectral Conditions of the Stars: C. D. Perrine, Observatorio Nacional Argentino, Cordoba. The spectral condition of a star depends chiefly upon its size and mass and the external conditions of density of cosmical matter and relative velocities of star and matter.

National Research Council: Minutes of the thirty-fourth, thirty-fifth and thirty-sixth meetings of the Committee; war organization of the National Research Council.

EDWIN BIDWELL WILSON
MASS. INSTITUTE OF TECHNOLOGY,
CAMBRIDGE, MASS.

SPECIAL ARTICLES

TERNARY SYSTEMS AND THE BEHAVIOR OF PROTOPLASM

I

IN order to define more accurately the nature of certain changes which are observed in protoplasm (its normal water content, edema, cloudy swelling, fatty degeneration, necrosis) we have been continuing our study of the behavior of various simple colloids so far as their powers of hydration and dehydration are concerned under the influence of changes in their surroundings. Since the chemistry of the proteins is rather complicated, we have turned to a study of the colloid behavior of the chemically simpler soaps, for these show close analogy in their processes of hydration and dehydration to certain proteins. The soaps, however, behave in their turn much like mutually soluble systems of the type phenol-water-salt, and so we have passed from a study of the soaps to a study of these simpler physico-chemical systems. From these we have then built backwards through the soaps to the proteins and from these to the properties of living cells. The study as a whole makes clearer, we think, the nature of various changes which are observed in living matter. Many of the "vital" phenomena of cells may be interpreted in the terms of the behavior of simple hydrophilic colloids. These in turn, may be interpreted as expressions of the changes to be observed in systems of mutually soluble materials (like two liquids and a solid, a liquid and two solids, etc.) more particularly the changes incident to their "separation" in their "critical realms" with the accompanying changes in viscosity, in light transmission, in state of "solvent" or "dissolved" substances, etc.

II

Our studies on soaps not only corroborate the work of various well-known authors (Hofmeister, Lewkowitch, Krafft, Merklen, Goldschmidt, Botazzi, Victorow and Leimdörfer), but amplify their studies in that we worked with pure (salt-free) soaps and with longer series of such while subjecting them to more widely varying external conditions than is the case in most of the investigations thus far reported.

We began with the preparation of equimolar amounts of various salt-free soaps in the presence of a definite volume of water. For this purpose we neutralized (at the temperature of boiling water) the proper fatty acid with an equivalent of the proper alkali in a unit volume of water. When not otherwise speci-

fied, our standard soap mixtures contain the proportions represented by a mol of the fatty acid neutralized by the gram equivalent of the proper metallic hydroxide, oxide or carbonate in the presence of a little water.

As long known from empiric practise, the different soaps bind totally different quantities of water. We first determined the absolute amounts of water that are absorbed by equimolar amounts of different *oleates* when prepared as described above. If that capable of holding most water is named first, the order in which these different soaps absorb water is about as follows; potassium, sodium, ammonium (?), lithium, magnesium, calcium, lead, mercury. Under the conditions of our experiments the first four bind all the water offered them (several hundred per cent.). Magnesium, however, holds but sixty per cent. its weight of water, and calcium oleate but forty. Even lower figures (about 10 per cent.) are obtained for the oleates of mercury and lead.

This general order in which the oleates with different basic radicals hold water is repeated by the *palmitates, margarates* and *stearates.* If the amount of water used in the preparation of the molar equivalents of soap is sufficiently reduced (to one fourth that stated above) then this same order may also be discovered in the case of the *caprylates.* These general findings seem therefore to justify the conclusion that *a first factor in the determination of the amount of water held by any soap resides in the nature of the basic radical combined with the fatty acid.*

We tried next to determine the effect of combining the same basic radical with different fatty acids of the same series. In these experiments we again neutralized one mol of the fatty acid with an equivalent of the necessary base (sodium or potassium hydroxide) in the presence of a constant volume (one liter) of water. The absolute amount of water taken up by a mol of any of these salts, as determined by discovering the maximum amount of water which such will take up at room temperature and yield a stiff jelly, increases progressively with the increase in the molecular weight of the fatty acid used. The absolute amounts of water absorbed vary enormously. From the lower members of the series (from the formates through the caproates) no colloid jellies at all can be obtained. The crossing line is well marked by sodium or potassium caprylate. These soaps form clear (molecular) solutions in twice their weight of water but they form jellies with once their weight of water. The amount of water that will be thus taken up and yield a jelly increases progressively as acids above caprylic are used so that by the time stearic acid is reached, one part of soap will easily take up a hundred or even two hundred times its weight of water and form a solid mass. Experiments with fatty acids beyond stearic are not yet completed. Obviously then, with a given base, *a second element in the amount of water held by a soap depends upon the nature of the fatty acid contained in the soap and its height in the series.*

We tried next the effects of different alkalies, of different neutral salts and of different non-electrolytes upon the hydration capacity of different soaps (caprylates, laurates, oleates, palmitates, margarates and stearates of sodium and potassium). Our conclusions under this head may be summed up as follows:

1. The addition of any *alkali* to a "solution" of any of these soaps at first increases its viscosity or (in a limited volume of water) leads to its gelation; with higher concentration of the added alkali, there follows a decrease in viscosity ("liquefaction") which change is succeeded, at sufficiently high concentration of the alkali by complete separation of the soap from the dispersion medium as a dry mass floating upon the "solvent." When equimolar solutions of the different soaps are compared it is found that the effects of an added alkali vary with (*a*) the fatty acid in the soap, (*b*) the base combined with the soap and (*c*) the basic radical of the added alkali. The lowermost members of the fatty acid series neither gel nor come out of "solution" upon addition of an alkali. The caprylates gel and come out easily while the higher soaps show these changes in increasingly marked

degree. When potassium and sodium soaps are compared, it is found that an added alkali will produce the series of changes earlier in a sodium soap than in a potassium soap. Similarly, if the effects are compared of adding equinormal solutions of potassium or sodium hydroxide to a given soap the former is found not so effective (in other words, a higher concentration is demanded to produce the series of changes noted above) as the latter. When solutions of the hydroxides of the bivalent or trivalent metals are used, the effects of the metallic radicals and the formation of metallic soaps with their low hydration capacity dominate the picture. Such hydroxides, therefore, lead uniformly only to decrease in viscosity and separation of the slightly hydrated soap from the dispersion mediums.

2. The addition of *salts* of the bivalent and trivalent metals to potassium, sodium, ammonium and lithium soaps leads to a clouding of the mixtures, a decrease in viscosity and a decrease in power to gel. The picture is again dominated, in other words, by the production of the metallic soaps with their low hydration capacities. A more careful study of the hydration and dehydration of the soaps of the alkali metals under the influence of various salts is therefore, limited to the salts of the alkali metals. As generally known in technological practise, these salts lead to a "salting out" of the soap, or, when used in smaller amounts, to a "gumming" or "stringing" of the soap. We were able to confirm and amplify here the investigations of other workers in this field which have shown that such gumming and ultimate salting out are dependent upon the concentration and the chemical nature of the salt used. With rare exceptions (more particularly those salts which in aqueous solutions are not "neutral") all the ordinary salts of potassium, sodium, lithium, etc., at first increase the viscosity of a potassium or sodium soap to a point where at proper concentration a soap jelly results, beyond which further increase leads to a fall in viscosity (liquefaction) until, in still higher concentrations of the salt, the soap begins to separate from its clear dispersion medium, at first as a cloudy jelly and then as a (practically dry) dehydrated soap mass swimming upon the clear "solvent."

The intensity with which these successive changes are brought about again varies, at the same concentration of salt, with the fatty acid in the soap, the nature of the basic radical in the soap and the basic radical of the salt used. Potassium salts, for example, are less effective in bringing about the series of changes than the corresponding sodium or lithium salts.

The acid radical (fluoride, chloride, bromide, iodide, nitrate, sulphocyanate, sulphate, acetate, tartrate, citrate) in the series employed by us seems to influence the end results so little as to come within the limits of experimental error. In other words, with salts of a given base the acid radical is practically of immaterial importance.

When *an alkali and a salt are together added* to a soap, the action of the two is found to be algebraically additive. An alkalinized soap may be salted out by adding a neutral salt and at a concentration of the latter which would not by itself have proved effective. Vice versa, a partially salted soap may be completely dehydrated by adding an alkali to a concentration at which the alkali alone would have produced no such effect.

It is also of interest that all these effects of alkali, of salts, etc., are largely reversible. A soap dehydrated by an alkali or a salt can be rehydrated by merely adding water; a soap partially dehydrated by a sodium salt can be rehydrated by substituting a potassium salt, etc. Most interesting, however (and physiologically important), is the fact that magnesium, calcium and even iron and copper soaps can, through the addition of the proper salts or hydroxides of the alkali metals, be slowly brought back into the more highly hydrated soaps of these alkali metals.

3. The *non-electrolytes* (alcohol, glycerin, dextrose, saccharose, lactose, urea) as compared with the electrolytes have at the same concentration relatively little effect upon the hydration and dehydration of soaps. They

tend in general to inhibit that series of changes which may be brought about in soaps through a lowering of temperature, the addition of alkali, the addition of salt, etc.

These findings indicate, therefore, that *a third element in the hydration and dehydration of soaps is resident in the kind and concentration of various alkalies, salts or non-electrolytes which may be present in the system.*

Great care is necessary before it is assumed that in order to understand the behavior of any *mixture of soaps* it is only necessary to compound the behavior of the individual pure soaps. The higher fatty acids uniformly yield soaps of the highest absolute hydration capacity, and yet if mixtures of a higher fatty acid soap and one lower in the series are prepared at the temperature of boiling water, the physical properties of the system on cooling are dominated by those characteristic of the *lower* fatty acid soaps. A hydrated sodium or potassium stearate, margarate or palmitate which at room temperature is absolutely solid becomes only viscid or remains distinctly liquid when small amounts of the caprylates, laurates or oleates are mixed with the stearate.

III

It must first be pointed out that *all the laws here emphasized as governing the hydration and dehydration of soaps are identical with those which govern the hydration and dehydration of certain proteins (like the globulins).* Whatever is the ultimately accepted theory of the nature of the action of the elements enumerated above in producing hydration and dehydration ("precipitation") in soaps, this will also prove to be the accepted one for this class of proteins. As the soaps (but not the fatty acids) are "soluble" in water so also are the alkalinized globulins (but not neutral globulin). As low concentrations of the alkali metals favor the hydration of soaps, thus also do they favor the hydration of globulin; on the other hand, as these same salts in higher concentrations "salt out" the former, so also do they salt out the latter. As the heavy metals, whether added as hydroxide or as salt, yield sparsely hydrated metallic soaps, so also do they yield sparsely hydrated globulins. As reversion of hydration or dehydration in soaps is easy when the salts of the alkali metals are involved, becomes increasingly difficult with magnesium and calcium compounds and proves only partially successful and then only after a long time when salts of the heavy metals are used, so also are the analogous reversions easy or difficult in the case of the globulins.

IV

To explain these changes in soaps, in various proteins and in living cells which have been subjected to similar changes in their surroundings we turn to the changes which may be seen in mutually soluble systems of the type phenol-water-salt as studied by Friedländer and his followers and as variously considered as of importance for an understanding of the changes in colloids[1] by Hardy, Höber, Wolfgang Ostwald and Hatschek.

Thus, water is soluble in phenol and phenol in water; similarly, water is soluble in soap and soap in water. The maximum viscosity of a phenol-water mixture appears in the critical realm when, under changes in surroundings or composition, phenolated water "separates out" in hydrated phenol or hydrated phenol appears in phenolated water. Soaps, similarly, show a maximum viscosity when a proper hydrated soap is produced in soap water or soap water separates out in hydrated

[1] We accept as the correct definition of "colloid," the dispersion of one material in a second, the degree of dispersion being less than that represented by the molecular degree of subdivision characteristic of "true" solutions. Limiting ourselves to the groups of dispersoids represented by solid-liquid and liquid-liquid mixtures (those of chief interest, biologically) we do not think that the former yield always suspensoids and the latter emulsoids, but that *either* type may result. (Liquid) mercury in water or (liquid) oil in water yield suspensoids while (solid) ferric hydroxide or crystallized albumin in water yield emulsoids. *The emulsoids result when each of the phases is soluble in the other;* the suspensoids when not more than one of the phases is soluble in the other.

soap. When an alkali or a salt is added to a phenol-water or to a soap-water system the "solubility" of each of the three phases in the remaining two changes. A clear "solution" of phenol, water and salt (at definite temperature) can be obtained only at proper concentrations of these three materials. Changes in any of them lead to changes in viscosity, changes in optical properties, changes in the distribution of one or more of the "dissolved" substances in the other phases, etc. This is also true of soap and individual proteins as discussed above and of protoplasm under physiological and pathological circumstances as noted in our earlier papers. What happens depends upon the chemical nature of the original substances entering into the mutually soluble system, their concentration and the temperature.

Applied to protoplasm we incline to the view that this consists of a series of hydrophilic (protein) colloids which have sucked up ("dissolved") a certain amount of water and a certain amount of various salts. The system is not unlike phenol saturated with water and containing "dissolved" in it various electrolytes and non-electrolytes. We hope to discuss in detail later, older experiments and our own which show how, at constant temperature, physical and chemical variation in any one of the substances in such simple systems is followed by change in the remaining ones and this in a fashion identical with certain changes observed in protoplasm. These mutually soluble physico-chemical systems show a normal water content (normal turgor) which may be decreased (cell shrinkage, plasmoptysis) or increased (plasmolysis, edema); accompanying such there are changes in viscosity (drying or swelling of tissues), changes in optical properties ("cloudy" swelling) and changes in distribution of dissolved substances ("vital" absorption or secretion). These changes in physico-chemical systems or in protoplasm may be brought about by changing (1) the fundamental type of the substrate itself (as when calcium or magnesium proteinate is substituted for potassium or sodium proteinate), by changing (2) the concentration of the electrolytes or non-electrolytes acting upon the substrate (either by increasing the amount of an alkaline metal in a cell, or by adding so much that it combines with the water of the cell and leads to protoplasmic dehydration through deprivation of "solvent" as first brought out by Hofmeister), or by changing (3) the chemical character of the salt acting upon the substrate (as when magnesium or iron salts are used instead of salts of the alkali metals). Some of these changes are reversible (like those produced by alkalies or alkali metals, in which case the corresponding tissue changes, as "edema" or "cloudy swelling," are also reversible), while others are not (in which case the changes in protoplasm, like the effects of a heavy metal, are also irreversible or incurable, and the involved tissues are said to suffer "death" or "necrosis").

The effect of changes in temperature upon these ternary (or more complicated) physico-chemical systems is also analogous to the effect of temperature upon protoplasm. As mutual "solubility" may increase or decrease with increase in temperature, a change in the system may occur in one or the other direction. The clearing of a turbid soap-water-salt or a globulin-water-salt system when the temperature is raised illustrates the one type of reaction, the "coagulation" of an albumin the other.

V

This more detailed study on soaps has enabled us also to study further and to *verify our earlier contentions regarding the conditions which make for the maintenance and the breaking of emulsions.* We have previously emphasized that oil can not be emulsified in water to yield an oil-in-water type of emulsion containing more than a fraction of one per cent. of fat, except as a colloid substance is present which unites with the water and forms a colloid hydrate. The truth of this general statement is verified by using as emulsifying agents the soaps described above. The lowermost members of the fatty acid series (which in water form only molecular solutions) do not make emulsification at all pos-

sible. The caprylates, which are the first in the series to show distinct hydrophilic properties, are good emulsifying agents, and, generally speaking, the value of these emulsifying agents increases steadily as we mount in the fatty acid series. An upper optimum is shown by those soaps which (like sodium stearate) are brittle and "dry" at ordinary temperatures. But the potassium soaps of these higher fatty acids are all good emulsifiers as are even the sodium soaps if the temperature is increased whereby the brittle, crystalline, colloid hydrates formed at lower temperatures are converted into more tenacious colloids which bear stretching into thin layers without rupture.

How important is the degree of hydration of the soap for thus stabilizing the emulsions is also well shown when the effects are studied of adding an alkaline salt in progressively higher concentrations to one of the more liquid soaps (like sodium oleate, sodium caprylate, sodium laurate or potassium palmitate, margarate, or stearate). As previously noted, the hydration capacity of the soaps is increased at first, decreased later and finally reduced to zero. Similarly the emulsifying power of the soap at first increases then decreases and finally becomes zero.

Martin H. Fischer,
Marian O. Hooker

Eichberg Laboratory of Physiology,
University of Cincinnati,
June 15, 1918

FIELD CONFERENCE OF CEREAL PATHOLOGISTS

The fourth Annual Conference of Cereal Pathologists was held at Purdue University, Lafayette, Ind., beginning June 19 and ending Friday afternoon, June 21. Forty names were signed to the register. A tentative program was presented as a guide for discussion, although no formal program had been prepared in advance. This fact helped to make the meetings more informal and all discussions were in the nature of round-table talks. Certain members were asked to lead in the discussion upon topics in which they were especially interested.

8:30 A.M., June 19—24 Present.

Professor H. P. Barss called the conference to order and after a few introductory remarks the program was taken up.

Barberry Eradication.—Dr. Stakman reported upon progress of the work of barberry eradication. Among other things he brought out the fact that barberries were much more numerous and more widely distributed than had been supposed, that they were quite universally rusted even on well-kept lawns, that in the northern United States, all cases of early infection of stem rust upon grains and grasses had been directly traceable to barberries and that the barberry campaign was succeeding in rapidly clearing the states from Ohio to Montana and from Missouri to Canada of this worthless shrub. He said that reports had come in indicating that 70 to 90 per cent. of the bushes were already out in North Dakota, South Dakota, Minnesota, Wisconsin, Iowa, Michigan, Nebraska and northern Illinois. The fact was also brought out that the common barberry has escaped from cultivation in some few places.

Dr. A. G. Johnson reported finding a hybrid of the common barberry which was infected. He emphasized three points: (1) Barberries spring up from the roots when dug up, if the work is not thoroughly done; (2) seedlings of barberries had been found badly infected; (3) barberries had been located in many obscure places. Mr. Dixon, of Wisconsin, reported on some work upon overwintering of uredinia. He found no overwintering of uredinia in 125 stations visited every two weeks during winter and spring. Dr. Stakman stated that this had also been the experience of various other field scouts both this year and last.

Dr. Coons reported good progress in Michigan and stated that the strong arm of the law was needed to complete the work. All barberries had been removed which could be removed by publicity work. He also stated that no stem rust had been observed until after infection had become common upon barberries.

Professor Selby reported good progress from Ohio. He stated that the attitude of the people in general was to wait for infection.

Professor Jackson stated that the scouting work in Indiana had been confined to the northern part of the state.

Dr. Stevens and Dr. Anderson were both present from Illinois. They stated that infection was abundant in Illinois in the northern part, and down the Mississippi River as far as Rock Island.

Stem Rust Studies.—Dr. Stakman reported very

briefly upon some recent work upon biologic forms of stem rust. He stated that a new strain of *Puccinia graminis* had been sent in from Oregon which had proven to be different than any previously described.

A general discussion followed concerning the general scope of the barberry campaign—the advisability of extending it into other states, etc.

7:45 P.M., June 19—28 Present.

Other Diseases of Wheat, Barley, Rye and Oats.—Dr. Johnson reported upon two distinct bacterial diseases of oats—one "halo blight" and the other striped bacterial disease.

Black chaff bacterial disease of wheat was reported as occurring this year in various states and causing some damage. Bacterial diseases of barley and rye, *Septoria* disease of wheat, *Rhynchosporium* disease of barley, anthracnose and *Helminthosporium* diseases were briefly discussed as to their distribution. This is not included here as such data are given by the Plant Disease Survey Reports.

Dr. A. G. Johnson reported upon some dry heat experiments which seemed to promise to control certain of these seed form diseases which are resistant to common methods of seed treatment.

9:30 A.M., June 20—32 Present.

Leaf Rusts of Cereals.—Leaf rust of wheat and rye was reported as being extremely heavy and extremely abundant in the south and as common in various sections.

Dr. Melhus from Iowa reported *Rhamnus lanceolata*, a native buckthorn, heavily infected in Iowa, and stated that the crown rust of oats goes to this species of *Rhamnus* according to greenhouse tests.

Some discussion followed regarding a method of determining losses by leaf rust.

A short report of recent researches upon stripe rust was given by Mr. Hungerford.

Species of Bunt and their Distribution.—After some general discussion, an effort was made to learn by reports from those present, something regarding the distribution of the two species of bunt. This did not result in any very satisfactory reports and Mr. Potter was finally appointed to look up the distribution of the two forms in various herbaria.

Loose Smut of Wheat.—This discussion brought out nothing which can not be learned from the Plant Disease Survey Reports.

2 P.M., June 20.

Field excursion to Wilson Farm (Experiment Station) in charge of Professors Jackson and Hoffer.

7 P.M. Dinner followed by round-table discussion—40 Present.

After the dinner, a rising vote of thanks was given to Dr. H. S. Jackson and Professor G. M. Hoffer for their hospitality and kindness in arranging for the cereal disease meeting.

At the business session Dr. G. H. Coons was chosen chairman and Dr. Robert Rands, secretary for the coming year.

A committee consisting of Dr. Stakman, Dr. Johnson, Dr. Melhus and Professor Barss was appointed to arrange for the time and place for the next meeting.

Dr. Selby invited the conference to meet in Ohio and Dr. Anderson extended such an invitation from Illinois.

Moved and carried that a committee upon resolutions be appointed—Anderson, Johnson, Stakman and Whetzel appointed.

Bacterial Diseases.—Bacterial diseases and corn rust were very briefly discussed. Professor Barre reported that *Physoderma* disease was one of the most troublesome and serious of all corn diseases. Distribution reported as practically over corn belt, although serious only farther south. A general discussion of corn smut followed.

9 A.M., June 21—36 Present.

Dr. Haskell submitted for criticism and suggestions, blanks prepared by Dr. Lutman for use in cereal disease estimates in Vermont and adopted by the Plant Disease Survey for general use. Several minor suggestions were made.

Smuts of Oats.—A general round-table discussion followed as to the distribution of loose and covered smuts of oats. Mr. Potter was instructed to include oat smuts in the survey work of herbaria in regard to species of bunt.

In the discussion which followed regarding barley smuts and stalk smut of rye, Dr. Coons urged that the treatment for rye smut be pushed so as to prevent its spread. Dr. Johnson raised the question regarding possible introduction of flag smut of wheat on wheat from Australia. It was moved and carried that the committee upon resolutions prepare resolutions to the Federal Horticultural Board in regard to use of wheat from Australia for seed purposes.

Smut Eradication Campaign.—Report by Mr. Reddy of work in North and South Dakota indicated that the main value of work there was in securing treatment of barley and oats.

Professor Barss reported that a standard label for use of druggists in Oregon had been prepared and distributed and that the campaign in Oregon

had resulted in uniformity of methods of treatment.

Mr. Morgan stated that bluestone was commonly used in Alabama and Mississippi and farmers treat every other year. Results of treatment in South Carolina showed control of oat smuts.

Dr. Johnson stated that the campaign had resulted in general stimulation of seed treatment in Wisconsin.

Dr. Reed reported that there was practically no control practised in Louisiana, Arkansas and Missouri. The campaign this year is convincing the people that they have smut and a campaign for eradication can be pushed next year.

Seed Treatment Methods.—General discussion of seed treatment methods and cooperation experiments followed. At Dr. Stakman's suggestion, it was moved and carried that the conference go on record approving the cooperative plan of seed treatment experiments.

Haskell and Iowa Treatments.—Iowa method as described by Dr. Melhus: One pint formaldehyde to ten gallons of water on forty bushels of grain. Grain to be sacked at once.

Dr. Whetzel reported that a certain elevator company near Ithaca, N. Y., was using the concentrated formaldehyde method on a large scale.

It was suggested that the treatment described by Dr. Haskell be known as the concentrated formaldehyde treatment.

Report of Committee upon Resolutions.—The following resolutions were presented by the committee upon resolutions and voted upon in turn, each one passing by unanimous vote:

1. We, the Cereal Pathologists in conference assembled at Lafayette, Indiana, after summarizing the evidence accumulated against the barberry as a spreader of black stem rust,

Do heartily endorse the efforts now being made under the leadership of the Department of Agriculture for the eradication of the forms of barberry and Mahonia, susceptible to black stem rust as a war measure of special importance in the conservation of our cereal food supply.

And be it resolved that we urge upon the Department of Agriculture and the agricultural agencies of the various states that the work be extended as speedily and pushed as vigorously as possible in order to give maximum production.

2. WHEREAS, the control of cereal smuts is of paramount importance and whereas, it is essential to learn the effect of different treatments on seed germination and yield, as used upon various cereals in various regions, under different conditions and on various varieties and seed lots with a view to standardizing treatments insofar as possible. Be it therefore resolved, that we, Cereal Pathologists urge (1) The continuation of the present smut eradication campaign U. S. Department. (2) Endorse and support the efforts now being made under the auspices of the War Emergency Board to solve the problems in connection with cereal seed treatment.

3. WHEREAS, Dr. J. C. Arthur, with rare devotion to science and foresight into the problems of the future, has done a tremendous amount of work fundamental to the development of cereal pathology,

AND WHEREAS, recognizing the fine service he had rendered we wish to express our appreciation of and admiration for this self-sacrificing work.

Be it, therefore resolved that we, the Cereal Pathologists assembled at Lafayette, Ind., June 19–21, do hereby express a sincere vote of thanks to Dr. Arthur for the concrete results he has obtained and the inspiration he has furnished, and be it further resolved, that a copy of this resolution, be sent to Dr. Arthur and also be published in *Phytopathology*.

4. WHEREAS, a large quantity of wheat is being imported into the United States from Australia for food purposes, and

WHEREAS, some of the wheat so imported may be used for seed purposes, and

WHEREAS, certain wheat diseases prevalent in Australia and not now in this country, may thereby be introduced into your country,

Be it resolved, by the cereal pathologists in meeting assembled at Lafayette, Ind., June 19–21, that the Horticultural Board be requested to take immediate steps looking toward the prevention of the introduction of such diseases.

CHAS. W. HUNGERFORD,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, AUGUST 16, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

GROVE KARL GILBERT[1]

GROVE KARL GILBERT was one of the most eminent geologists of the world. As he was a native of Rochester and an honorary member of this society, the Academy of Science has special pride in his life and work.

Dr. Gilbert was born in Rochester, May 6, 1843. His father was the well-known portrait painter, Grove Sheldon Gilbert. For many years the family lived in the little house at the intersection of Culver Road and Merchants Road, but Karl was not born there. He had six brothers and sisters. The usual want of thrift and acquisitiveness in men of the artistic temperament held in the case of the father, and it appears that the family was poor and that Karl had to obtain some help for his course in college. He graduated as Bachelor of Arts at the university in 1862.

Following his graduation he taught for one year as principal of the schools in Jackson, Mich. He then returned to Rochester and until 1868 was assistant to Henry A. Ward. This work on the geologic and zoologic material of Ward's establishment probably determined his future scientific career. Many thousands of the labels in the University Geological Museum, which was the famous Ward collection, carry the pen-work of young Gilbert.

In 1869 he began, on the Ohio Geological Survey, under Professor J. S. Newberry, his geologic work. That this work was deliberate choice appears from the "Historical Sketch" by Newberry, in the report for 1869 (page 9), where we read:

> Of the other members of the corps, Messrs. Gilbert and Sherwood were geologists who had devoted much time to practical geology in New York and Pennsylvania, and who, for the purpose of adding to their experience, volunteered their serv-

[1] Memoir presented to the Rochester Academy of Science.

ices for no other compensation than their traveling expenses.

In the report for 1870 Dr. Newberry writes:

The fossil fishes and fossil plants found in the state have been described by myself. They have been drawn by Mr. T. Y. Gardner and Mr. G. K. Gilbert in a style that has not been surpassed in this country, and some of their work is equal to any of a similar character done by the best European draughtsmen (page 8).

This volume contains a short report by Gilbert on three counties in the northwestern part of the state.[2] A fuller report on the same district is attached to a report on the surface geology of the Maumee Valley, found in Volume 1, of the final reports of the Newberry survey. This writing, published in 1873, contains six maps, evidently all his own work. The first two maps show the beaches of the ancient glacial waters in the Maumee Valley, and the correlation of the highest shore with the pass at Fort Wayne.

These fine maps are the first ever made in delineation of ancient lake beaches and correlation with the controlling outlet. The field work for this report was done in 1869 and 1870, when he was only twenty-seven years of age. At this time Gilbert did not recognize the receding ice sheet as the dam that held up the ancient waters, but he did clearly postulate deformation of the earth's surface as one cause of the variation of levels. He says (page 551):

The more general conclusion that the system of raised beaches signify a succession of flexures of the earth's surface, rather than successive stages of subsidence due to the gradual removal of a barrier of tide water, or the gradual wear of a barrier of stone, does not rest on this single fact.

Even then he knew something of the change of levels in the Ontario basin, for he immediately says, in citing other similar facts: "There is evidence that Lake Ontario, at Rochester, N. Y., has stood 70 feet lower than it does now" (page 552). Some sentences in the same connection illustrate his capacity for generalization.

[2] Part VII., pp. 485–499.

While these facts abundantly prove that a simple theory of gradual drainage, by the elevation en masse of the lake regions, is entirely inadequate, they are too fragmentary to define clearly the general synchronism and sequence of the local movements to which they testify. Nevertheless, it is something to have learned that the writhing of the surface of the earth, which has in the ages so many times remapped the continents, has also been the great immediate cause of the transformations of the great lakes, and that, continuing through the latest distinguishable geological epoch and its prolongation the historical, it has now ceased.

Dr. Newberry was the first geologist to recognize the ice barrier as the cause of the high-level waters in the Laurentian basin, and it is interesting to find a footnote over his initials, at the bottom of the same page (552), reading as follows:

In the discussion of these facts cited by Mr. Gilbert, and others of similar character, it should be remembered that the retreating glacier must have, for ages, constituted an ice dam that obstructed the natural lines of drainage, and may have maintained a high surface level in the water-basin which succeeded it.

The substance of Gilbert's report in the 1873 volume of the Ohio Survey had previous publication by permission in the *American Journal of Science* in 1871.[3] An abstract was also printed in the proceedings of the New York Academy of Sciences of February 20, 1871 (pp. 175–178).

In 1871 Gilbert joined the Wheeler survey of the western territories and began the many years of work in the far west. From 1875 he was on the survey under Major Powell. The United States Geological survey was organized in 1879, with Clarence King as director, and young Gilbert became a member. From that time to his death, May 1, 1918, he was continuously on the national survey.

Gilbert was not a prolific writer, as compared with others and judged by his work and ability. Down to 1891 the bibliographic list carries 70 titles, four of which have associated authors. His initial publication, in recognized geologic mediums, was in 1871, on the Cohoes mastodon in the twenty-first annual report of

[3] Vol. 1 of third series, pp. 339–345.

the New York State Cabinet of Natural History. His next three articles have been noted above, relating to Ohio geology and the ancient beaches. From 1871 his papers are mostly in description of features of the western country. The most important of his earlier papers is the report on the Henry Mountains, published 1877. In this classic paper he described a new type of mountains, now fully recognized. These were originally domes, or areas of sedimentary strata lifted by the injection of lava from beneath. Quoting his own description, page 19:

> The lava of the Henry Mountains behaved differently. Instead of rising through all the beds of the earth's crust, it stopped at a lower horizon, insinuated itself between two strata, and opened for itself a chamber by lifting all the superior beds. In this chamber it congealed, forming a massive body of trap. For this body the name laccolite (cistern-stone) will be used.

In later years the name has been changed to laccolith. Subsequent erosion of these uplifts by doming has often destroyed the arching form or obscured the primitive shape and exposed the injected igneous heart. The latter part of this book is a discussion of land sculpture. In this statement of the principles of erosion and the origin of topographic forms he shares with Newberry and Powell the honor of a pioneer.

Probably his most famous writing is the work on Lake Bonneville. This is the initial volume of the series of quarto monographs published by the National Survey, and bears the date 1890. This describes the wide expanded predecessor of the present Great Salt Lake, which existed in glacial time when humidity and rainfall of the Great Basin produced the vast lake which overflowed northward to the Columbia River. Great Salt Lake is only the saline remnant of that desiccated fresh-water body.

This handsome quarto volume contains a chapter on "Topographic Features of Lake Shores" which is the classic writing on shoreline topography.

It is interesting to note that he published no articles relating to the Rochester region until after his long period of western exploration. His first publication in reference to the Ontario basin was in 1885, on the Iroquois shoreline; although he then called it simply the old shore-line of Ontario. Between then and 1891 he published six papers on the Pleistocene features or glacial history of the Ontario basin; and one on the sink ridges near Caledonia.

From 1892 to 1900, eight years, his list of writings is forty; covering a wide range of subjects in geology. Of these eight related to western New York. From 1901 to 1905 twenty-five titles are on record, of which only two concern western New York. During 1906 and 1907 he published nine articles, one being on Niagara. In 1908 only four articles, including another on Niagara, are recorded in the bibliography. Since 1908 only five titles are credited. Altogether this makes 156 titles, of which 18 relate to the geology of western New York or the Ontario basin.

The few papers published in later years is explained by his poor health, due to a slight stroke of apoplexy. After this time by very careful living he was able to do some work in a deliberate way. His latest study was the transportation of detritus by streams, with reference to hydraulic mining in California. This work, spread over several years, was published last year, being his last publication. It is entitled "Hydraulic-mining Debris in the Sierra Nevada," and is Professional Paper 105 of the Survey list, forming a quarto of 154 pages, with numerous maps and reproduction of photographs.

Dr. Gilbert's only writing for school textbooks in his "Introduction to Physical Geography," in collaboration with Professor A. P. Brigham. This was published in 1892 by D. Appleton and Company.

Geology is so broad and comprehensive and so inviting in many directions that some men with active minds and lively interest scatter their studies over diverse fields. Dr. Gilbert more wisely confined his work to physical geology, especially geodynamics, in which he was recognized as a master. He published practically nothing in biologic geology or paleontology; and almost nothing in stratigraphy and petrology.

His geologic interest in his home region was mainly in glacial problems, especially the glacial lake Iroquois and the deformation of the Ontario basin. He was the first geologist to appreciate the complexity of the Pleistocene history of the valley. As early as 1885 he recognized the three controlling factors: (*a*) the damming effect of the waning glacier and the glacial nature of the earlier waters; (*b*) the succession of water levels due to opening of different outlets or places of escape for the impounded waters, by the recession of the glacier front; and (*c*) the dislocation and canting of the water planes by the tilting uplift of the land. His accurate conclusions regarding the complex history are embodied in a number of short papers, and especially in a chapter in the "Sixth Annual Report of the Commissioners of the State Reservation at Niagara for the year 1890." The title of this important but little-known paper is "The History of Niagara."

Dr. Gilbert's mind was of the reflective, philosophic type. He sought for the explanation and relationship of phenomena. His calm judgment and clear discrimination joined to a spirit of fairness and with gentle manners caused him to be much sought as a critic and helper. He was a sort of father-adviser to the members of the survey. Doubtless much of his thought has found expression in the writings of the younger men who revered and loved him. The writer of this appreciation never heard him say a harsh word of any one. He was reserved in personal matters, but it is known that the death of a young daughter affected and saddened his life. His wife, who was Fannie L. Porter, died over twenty years ago. Two sons are living.

Dr. Gilbert received many honors. The University of Rochester gave him the master's degree in 1872, and the LL.D. degree in 1898. The latter degree was also conferred by the University of Wisconsin. He was the fourth president of the Geological Society of America, in 1892, and was again president in 1909, the only man honored by a second term. In 1899 he was president of the American Association for the Advancement of Science, probably the highest honor in the gift of American science. Naturally he was active and prominent in the scientific societies of the national capitol, and was a member of the National Academy of Sciences. He was one of the very few honorary members of this society. In 1892, when the American Association for the Advancement of Science held its annual meeting in Rochester, this academy held a special meeting in Music Hall complimentary to the association, and the lecture of the evening was given by Gilbert, the subject being: "Coon Butte and the Theories of Its Origin." The relief map which he used on that occasion was donated to the university museum. It may be said that this was one of the very few times in which his theory has been proven wrong.

On the approach of his seventy-fifth anniversary, the sixth of last May, his friends were asked to send to the Survey letters of appreciation to be handed to him on that day. Unhappily he passed away on the first of the month at Jackson, Mich.

HERMAN LEROY FAIRCHILD

WAR BREAD

DR. ALONZO E. TAYLOR in his book "War Bread" gives a large amount of valuable information concerning the conservation of wheat under war conditions. Our duty is plainly set forth and many helpful suggestions are made.

There are two topics discussed in this book, "Food Value of the Different Grains," and "Ways of Stretching Wheat," which are of particular interest to the student of nutrition. Briefly stated, Dr. Taylor's conclusions are that the direct substitution of other cereals for wheat, and the judicious use of mixed flours, are the best ways of conserving wheat. Long extraction flours milled so as to include the germ or bran have not proved satisfactory for the making of war bread. A few quotations will perhaps best serve to give the author's conclusions upon these points.

> Direct substitution offers the most obvious way of saving wheat (p. 62).

> The best mixed-flour bread is prepared from flour of standard extraction. For practical pur-

poses it does not make much difference what the diluting flour is (p. 69).

In comparing American and European extractions, the water content of flours must be kept in mind. Here the flour contains about 13 per cent. of water, in Europe higher water content is permitted, 17 per cent. being common. In other words, our 75 per cent. extraction corresponds to a 78 per cent. extraction in Europe (p. 76).

The germ contains both ferments and bacteria, and is, therefore, prone to decomposition. The ferments split the fats, making them rancid. They act upon the protein also. Aided by bacteria, they produce the musty decomposition that is liable to occur in coarse flours, and does not occur in standard flours under the same circumstances (p. 77).

The common experience with whole wheat flour is that it spoils rapidly, even in the hands of the trade; and this is one reason why whole wheat flours are expensive (p. 81).

Breads made from flours containing the endosperm and the germ fraction are not unusually good breads. The writer has eaten breads baked from flours of 81, 85, 88, 93 and 97 per cent. extraction in Germany, England and France[1] (p. 82). European bakers have worked for over two years to produce good breads from these flours. It has not been routinely accomplished in any country. The methods of bread baking are very different in France, Italy, Germany and England. The standards of what constitutes good bread and the tastes of the public are different. In not one of these countries have the bakers been able to meet the tastes of the consuming classes with breads made from flours containing the endosperm and the germ fraction. The loaf is smaller, the moisture content higher, often tending to sogginess, does not crust well, and remains, when all is said and done, an unsatisfactory bread. The revulsion against this bread has been audible in every country, the people have repeatedly petitioned that they be given less bread and better bread (p. 83).

It has been the experience in the European countries that breads prepared from higher extraction flours do not agree with many individuals. This holds as true of breads made from the 85 per cent. extraction as from the 93 per cent. extraction. Many children and adults fail to digest these breads. The result is discomfort and often colic, gaseous fermentation, and resultant disturbances of intestinal functions (p. 84).

It is the experience of the nations at war in Europe that they would abandon higher extraction and return to mixed flours, prepared from standard flour, provided this were possible. Breads made in England of Standard American flour diluted with an admixing flour are much better than straight breads of 85 per cent. extraction flour. The Victory Bread of the United States is so superior to the war bread of the Allies and of the enemies as to be past comparison (p. 86).

Dr. Taylor discusses, in a broad way, the mineral and vitamine contents of whole wheat and standard flours. He recognizes the common deficiency of all cereals in failing to supply certain fat soluble constituents which can be secured only through foods like milk, meat and leaf vegetables, and hence he can see no gain in the substitution of whole wheat for standard extraction flour. He says:

In the diet of the nations at war there is a profusion of vegetables, more than in peace time, that contain minerals, roughage and vitamines freely. Go where one will, in the United Kingdom, France, Germany, Switzerland or Holland, one finds the diet of the people to-day rougher, coarser and containing more vegetables and less concentrated food stuffs than in peace time (pp. 87–88).

Under these circumstances, the plea for whole wheat flour in the American diet to-day fails of justification from this point of view. People should be allowed to select their roughage, whether in the form of fruits or vegetables, or in the form of whole grains. They should be allowed to select their mineral salts and vitamines in the same manner, and both are freely available. The legal distinction between food conservation and health propaganda must be kept in mind. It is argued in favor of whole wheat flour that its use might relieve or prevent constipation, rickets, scurvy, anaemia and pellagra. But the function of a food administration is to secure and conserve food, not treat preexisting diseases in a compulsory manner, applied to the majority who are not afflicted, as well as to the minority who may be diseased but still possess the right to select their treatment. In each country at war diet fads are being pushed at the food administration, who must confine themselves to the specific functions defined by legislative authorization (pp. 89–90).

As Dr. Taylor is a member of the U. S. Food Administration, and of the War Trade Board, Washington, naturally any statements which he publishes, particularly at this time, are of

[1] Note as Dr. Taylor explains, 81 European extraction would be 78 American basis.

more than momentary interest. The book is dedicated to Herbert Clark Hoover in the hope that it may aid his fellow citizens to support him.

HARRY SNYDER

THE BOTANY AND PLANT PRODUCTS OF NORTHERN SOUTH AMERICA

A COOPERATIVE investigation of the flora of northern South America, which, when carried out in detail, should be of highly significant scientific and economic importance, has recently been organized by the New York Botanical Garden, the United States National Museum, and the Gray Herbarium of Harvard University. This investigation is planned to include the plants inhabiting the Guianas, Venezuela, Colombia, Ecuador, and the adjacent Caribbean islands, Trinidad, Tobago, Margarita, Bonaire, Curaçao and Aruba.

The immediate object is to secure and organize collections of size and excellence from as many different floral areas as may be found feasible; to assemble all knowledge obtainable relative to the distribution of the species, their habitats, and their uses; and thus to acquire in North America, materials for critical investigations leading to much needed monographs of important groups and to detailed catalogues of floras as yet very inadequately known.

The region contemplated has great diversity of climate, soil and altitude and a corresponding wealth of vegetation. Perhaps no area of greater botanical promise has thus far received less organized floral investigation. Nor have the scattered results obtained in the past ever been brought together into correlated or accessible form, being at present scattered in fragmentary publications, foreign journals and casual works of travel, with the result that information even in regard to many plants of considerable economic promise is excessively difficult to assemble and surprisingly scanty when obtained.

In this rich and varied flora of northern South America is sure to be found a wealth of plants capable of yielding commercial timbers, drugs, vegetable oils, tannin, gums, waxes and essences of technical value, dye-stuffs, food-materials, fibers and countless substances such as rubber, highly significant in manufactures. Many of these products are reaching our markets in mixed or imperfect condition owing to inadequate knowledge of the precise plants from which they should be obtained. In other instances, although the species may be known, the range and availability is still too obscure to encourage enterprises of exploitation.

Recent events have shown how suddenly and unexpectedly America may be cut off from many European sources of manufacture and information. It is increasingly evident that all the American countries should gain the manufacturing and commercial independence which may be derived from a thorough scientific investigation of their natural resources. Among these the tropical American vegetation is one of the most significant and merits much more earnest investigation than it has thus far received.

It is confidently believed that the proposed studies will do much to extend the knowledge of South American products, and thus to increase trade and conduce to friendly relations with the countries concerned.

In the realm of pure science the results obtained will also have very important bearings on the studies of Central American vegetation already prosecuted by the National Museum and by the Gray Herbarium, and on those of the West Indian flora conducted by the New York Botanical Garden.

The scientists in charge of the botanical collections of the three cooperating institutions and other botanists and economists have long known the need for organized information relative to the vegetation of northern South America; these collections already contain specimens derived from various sources in the past, representing a considerable proportion of the plants inhabiting the region, and of their products, but much of this material has not been critically studied nor determined botanically. Old World museums and herbaria contain a more complete and better studied representation than American institutions possess. The extensive literature of the sub-

ject is, however, measurably complete in our libraries, but scattered under many hundred titles, mostly by European authors.

The investigation is primarily planned along the following lines:

1. The study, naming and cataloguing of specimens already in the three institutions. This work will incidentally much increase the reference strength of our herbaria and museums.

2. The increase of the three collections by specimens obtained through field expeditions sent to parts of the area as yet little known botanically, or in search of species of other areas as yet incompletely understood. Duplicate specimens beyond the three sets required will be distributed to other institutions in exchange. Friends of the institutions may furnish important aid by sending funds to any of them for the expenses of field expeditions.

3. The publication of advanced papers from time to time, dealing with portions of the investigation on which results have been reached, without awaiting the completion of the annotated catalogue.

The cooperative effort includes the following methods:

1. The subdivision of the work among staff members of the three institutions and among specialists of other institutions.

2. The loan of specimens from the collections of the three institutions to each other.

3. Visits of staff members of the three institutions to each other for the study of collections and for consultation.

4. Collections made by any of the institutions to be shared with the others.

5. Joint support of some of the field expeditions and division of the collections made.

Recent collections, the study of which has led up to the cooperative arrangement, include principally those made for the United States National Museum by H. Pittier in Venezuela in 1913; for the Gray Herbarium by J. A. Samuels in Dutch Guiana in 1916, and by H. A. Curran and M. Haman in Curaçao, Aruba, and northern Venezuela in 1917; and for the New York Botanical Garden by H. H. Rusby and F. W. Pennell in 1917 and 1918. The arrangement was consummated through correspondence between Dr. B. L. Robinson, of the Gray Herbarium, and Mr. Frederick V. Coville and Dr. J. N. Rose, of the National Museum, with Dr. N. L. Britton, of the New York Botanical Garden, in the latter part of 1917 and early in 1918, and it has been approved by the governing bodies and officials of the three institutions.

Professor Oakes Ames, of the Bussey Institution of Harvard University, has offered cooperation which has been gratefully accepted.

The first field expedition organized is one to Ecuador, led by Dr. J. N. Rose, of the United States National Museum; in this, the cooperating institutions are very materially aided by the Bureau of Plant Industry of the United States Department of Agriculture, the bureau desiring first-hand information about important economic plants which can be obtained only by field observations of a trained botanist. Dr. Rose left Washington on July 22, for an absence of about four months, and it is anticipated that the results of this work will add greatly to our knowledge of the flora and plant products of Ecuador.

The very large collections made by Drs. Rusby and Pennell in Colombia for the New York Botanical Garden are being organized for critical study, and will be divided among the three institutions as soon as possible.

SCIENTIFIC EVENTS

THE INTER-ALLIED FOOD COMMISSION

The arrival of experts representing the allies to consider the food problem was announced in a previous issue. According to the *Journal* of the American Medical Association the Inter-Allied Food Commission meeting in London has decided that the minimal food requirements of "the average man" (weighing 154 pounds) doing average work during eight hours a day represent an energy value of 3,300 calories daily. In case it should become impossible to supply this requisite amount of food, a reduction of 10 per cent. on the foregoing figure can be supported for some time without injury to health. The commission agreed to accept Lusk's figures as to the pro-

portion of this amount to be assigned to women and to children of different ages. The following conclusions have been agreed on: (1) To state the weights of the various foods produced in each Allied country in metric tons. (2) It is not desirable to fix a minimal meat ration in view of the fact that no absolute physiologic need exists for meat, since the proteins of meat can be replaced by proteins of animal origin, such as those contained in milk, cheese and eggs, as well as by proteins of vegetable origin. The commission, on the other hand, resolved to fix a desirable minimal ration of fat—75 gm. per average man per day. The ration will be made up of (*a*) fats of vegetable origin and (*b*) fats of animal origin. If the amount of fats of vegetable origin are insufficient for this purpose, it may be necessary to maintain a certain stock of animals to furnish this fat. (3) The commission established the "man value," that is, the number of average men equivalent to the population of each of the Allied countries. This "man value" is taken as the basis for calculating the exact amount of food which must be provided for the adequate nourishment of the total population of each country. (4) The commission considered the estimates in tons of the home productions of the soil furnished by each Allied country for the year 1918–1919. These statistics will serve as a basis for determining the amount of food available for men and for animals, respectively, in each country. (5) Each delegation, in calculating the amount of calories available for men, should assign to men the maximal possible proportion of all cereals, excepts oats. (6) A uniform average milling extraction of 85 per cent. for wheat should be adopted throughout the Allied countries. This extraction may vary from 80 per cent. in summer to 90 per cent. in winter, and it can apply to the United States only as regards their internal consumption, and then only in case of scarcity. (7) The methods of reserving the maximal possible proportion of the cereal production for the use of man may vary in each country. Man should always take precedence over animals in the allocation of food. If this principle be accepted in the fixing of prices, it is the prices of animal products which should be limited, rather than those of such vegetable products of the soil as may serve equally well for feeding men and animals. Thus the production of veal, pork and poultry at the expense of food available for man should be discouraged, and this is best achieved by fixing a price for those animal products which will make it unprofitable for the producer to feed them on cereals. (8) The commission reserved for its next meeting the task of examining the figures which will enable it to determine the caloric value of the home production of each of the Allied countries. The determination of this figure, compared with the needs in calories of the population of each country, will enable the commission to deduce the amount of imports necessary for the maintenance of the population or the exportable surplus, as the case may be. (9) In all the Allied countries, any propaganda, having for its object the encouragement of food production and of economy in the use of food, should be organized and directed by men of science well acquainted with the subject.

FOURTH NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES

The Fourth National Exposition of Chemical Industries will be held in the Grand Central Palace, New York City, during the week of September 23 this year. The managers are Charles F. Roth and F. W. Payne. The advisory committee consists of Charles H. Herty, *chairman*, Raymond F. Bacon, L. H. Baekeland, Henry B. Faber, Ellwood Hendrick, Bernhard C. Hesse, A. D. Little, Wm. H. Nichols, H. C. Parmelee, R. P. Perry, G. W. Thompson, F. J. Tone, T. B. Wagner and M. C. Whitaker.

The *Journal of Industrial and Engineering Chemistry* says that the exposition is a wartime necessity and, regarding it as such, each exhibitor is planning his exhibit to be of the greatest benefit to the country through the men who visit it, all of whom are bent upon a serious purpose—that of producing war materials in large quantities and constantly in-

creasing this production until the war has been won by the United States and its Allies.

The managers report that the amount of floor space already engaged is greater than last year, that the exhibits will be much more attractive, and that a movement is under way to show all exhibits of machinery in operation under actual working conditions as they would be found in the plants.

Some sections of the south are again sending exhibits, and Canada is taking the opportunity of presenting the materials it has available for development by the chemist and financier. A section for the Glass and Ceramic Industry has been added with which the American Ceramic Society is cooperating.

The program for the Exposition is in active preparation. Opening addresses will be made by Dr. Charles H. Herty, chairman of the advisory committee, and Dr. G. W. Thompson, president of the American Institute of Chemical Engineers. There will be a series of symposiums on "The Development of Chemical Industries in the United States, notably since July, 1914." This will embrace the period since the beginning of the European War, which, by removing the source of supply for our domestic industries, inspired the development of our own chemical industries which, now that we ourselves have entered the war, are proving so effective. The subjects to be discussed are Potash Development, Chemical Engineering, Acids, Industrial Organic Chemistry, the Ceramic Industries and the Metal Industries Among the speakers will be:

C. A. Higgins, "Recovery of potash from kelp."
Linn Bradley, "Recovery of potash from cement dust and other sources by electrical precipitation."
A. Hough, "Chemical engineering in explosives; T. N. T., T. N. A., picric acid and nitrobenzol."
E. J. Pranke, "Development of nitric acid manufacture."
S. P. Sadtler, "Development of industrial organic chemistry."
George H. Tomlinson, "Wood as a source of ethyl alcohol."
C. A. Higgins, "Kelp as a source of organic solvents."
Alcan Hirsch, "Pyrophoric alloys."
Joseph W. Richards, "The ferro-alloys of silicon, tungsten, uranium, vanadium, molybenum, titanium."
Theodore Swann, "Ferromanganese."
Leonard Waldo, "The development of the magnesium industry."

The American Ceramic Society, which will hold its meeting at the Exposition on Thursday afternoon, September 26, has already upon its program:

A. V. Bleininger, "Recent developments in the ceramic industries."
L. E. Barringer, "Manufacture of electrical porcelain" (illustrated).
H. Ries, "American clays."
F. A. Whitaker, "Manufacture of stoneware" (illustrated).

Following this meeting a series of motion pictures of the ceramic industries will be shown.

The motion picture program, in the arrangement of which the Bureau of Commercial Economics is again cooperating, carries forward the idea of the symposiums, the pictures appropriate to a subject being shown on the same day as the symposium on that subject is held.

NUTRITION OFFICERS STATIONED IN THE CAMPS[1]

NUTRITION officers are to be stationed in every National Army cantonment and every National Guard camp, as well as in every camp where 10,000 or more soldiers are in training. These officers are food specialists who before they joined the army as members of the division of food and nutrition of the Medical Department were connected with colleges and public bodies as physiologists, chemists, economists, food inspectors and experts in other specialized work relating to food.

Since October of last year the division of food and nutrition has been making surveys of food conditions in the camps. Groups of officers have gone from camp to camp, studied the food served, how it was inspected, stored, and prepared, and have made recommenda-

[1] Statement from the office of the Surgeon General authorized by the War Department.

tions which, upon being carried out, resulted in many advantageous changes.

Although the principal work of these groups was inspection of the manner of handling and preparing food, the visiting officers were able to give considerable instruction in the principles of nutrition, the proper selection of foods, and the construction of dietaries to mess officers, medical officers and others who were interested. Detailed personal instruction was given to the mess personnel on some of these topics, as well as on the various methods of avoiding waste, the importance of keeping kitchens and mess halls clean and orderly, and the methods of judging and storing food.

Survey parties were instructed to seek in every possible way to reduce waste. It was found that men and officers were very willing to cooperate in making surveys and to reduce as much as possible the waste of food. One of the most effective means adopted for this purpose was introduced at one camp and followed later at other camps.

At this camp seven companies were selected from various organizations, totaling 1,135 men. A two-day survey was run on each mess, and the average edible waste was found to be 1.12 pounds per man per day. Instructions were then given to the mess sergeants and cooks in matters of food and mess economy, and when the officer in charge was satisfied that they had a reasonable understanding of the subject a second two-day survey was made. This showed an average edible waste of 0.43 pound per man per day—a saving of 0.69 pound. This saving amounted to $61.75 per day for the seven messes, or at the same rate would amount to $22,542 per year. If the same rate of saving were brought about for the entire camp, in this case approximately 15,000 men, it would amount to $338,000 a year.

Work of this character showed the necessity of keeping a nutrition officer in each camp at all times so that he might advise about the composition and nutritive value of dietaries, make inspections for adulterations, spoilage, and deterioration, and to cooperate with the mess officials.

Sixty new officers are to be commissioned in the division of food and nutrition to handle the additional work. All will be food specialists similar to those already in the service.

GREETINGS TO FRANCE FROM BRITISH SOCITIES

MESSAGES to France on the occasion of France's day have been dispatched by all the leading societies and institutions in Great Britain, including the following scientific societies:

British Association.—Nineteen years ago the Dover meeting of the British Association was "so arranged that the two great nations which had been, a century earlier, grappling in a fierce struggle should in the persons of their men of science draw as near together as they could." Another joint meeting with France was on the point of taking place when our high hopes of lasting general peace were so cruelly destroyed. But out of the destruction has arisen a far closer union of our two peoples, and an even brighter prospect of our future cooperation for the good of humanity and science.

Royal Society.—The Royal Society of London sends greetings to the French nation and more especially to its scientific men. It recalls the intimate friendship which since their foundation has bound together the Académie des Sciences with its own body. Always united in their endeavor to promote the advance of science, they are now joined in their efforts to defend the cause of civilization and freedom.

British Academy.—To France, who has so often inspired and led civilization in Europe; to France, who upholds the banner of intellectual freedom and unfettered thought; to France, who for nearly four years has endured brutal outrage and the violation of all decencies of humanity and civilization, the British Academy, in the name of British scholarship, sends on this great anniversary a renewed assurance of loyal fraternity and of unshaken determination to continue the conflict until liberty is secured and French soil delivered from the desecration of the invader.

Royal College of Surgeons of England.—Brothers-in-Arms, we greet you. Bound by ancient ties of blood and by the memories of many a gallant contest in the past, to-day we stand as one nation united in a sacred cause. We have before us a happy presage from the past. As the united efforts of Pasteur and Lister have laid low the tyranny of disease, so shall France and Britain

conquer a tyranny still more remorseless. Our future brightens, and shall endow Gaul and Briton with a common birthright to remain a splendid heritage for all time.

SCIENTIFIC NOTES AND NEWS

The hundredth annual meeting of the Swiss Association for the Natural Sciences will be held at Lugano from September 7 to 11. The committee on organization states that the continuation of the meetings is of value equally to science and to the country. Public lectures will be given as follows: Parthenogenesis and apogamy, by Professor Ernst, of Zurich; The Swiss national parks, by Professor Schroeter, of Zurich; Man from the point of view of medicine and natural science, by Professor Nägeli, of Zurich; On the constitution of the chemical elements, by Professor Berthoud, of Neuchâtel. The association meets in twelve sections: (1) Mathematics; (2) Physics; (3) Geophysics, Meteorology and Astronomy; (4) Chemistry; (5) Geology; (6) Botany; (7) Zoology; (8) Entomology; (9) Medicine; (10) Pharmacy; (11) Engineering; (12) Agriculture, Forestry and Fisheries.

Dr. Samuel Avery, formerly director of the chemical laboratories in the University of Nebraska, and for several years chancellor of that institution, has been commissioned major in the Chemical Warfare Service, N. A., and placed in charge of the University Relations Section. Dr. Avery has been granted a leave of absence by the regents of the university for the period of the war.

Colonel John M. T. Finney, chief surgical consultant of the American Expeditionary Forces, has returned home on a mission connected with his work overseas.

Professor E. C. Franklin, of Stanford University, Professor W. J. A. Bliss, of Johns Hopkins University, and Professor C. M. Carson, of the Michigan School of Mines, are engaged for the summer on military work in the Chemistry Division of the Bureau of Standards.

Dr. W. R. Dodson, dean of the college of agriculture of the University of Louisiana, and E. S. Brigham, commissioner of dairying of Vermont, have become members of the Food Administration staff in Washington. Dr. Dodson has charge of problems of interest to both the Food Administration and the Department of Agriculture. Mr. Brigham will head the butter and cheese section. Dean H. L. Russell, of the College of Agriculture of the University of Wisconsin, who has rendered service to the Food Administration in the capacities which Dr. Dodson and Mr. Brigham now assume, has been recalled to Wisconsin by pressing duties at the university.

Dr. William C. Fowler has assumed office as health officer of the District of Columbia, succeeding Dr. William C. Woodward, who resigned to accept the position of commissioner of health of Boston.

Dr. J. N. Langley, professor of physiology in the University of Cambridge, Sir F. W. Dyson, astronomer royal, Dr. Horace Lamb, professor of mathematics in the University of Manchester, and Sir E. Rutherford, Langworthy professor and director of physical laboratories in the University of Manchester, have been elected foreign members of the Royal Academy "dei Lincei," Rome.

Dr. Barton Warren Evermann, director of the museum, Dr. John Van Denburgh, curator of the department of herpetology, and Mr. Joseph R. Slevin, assistant curator, department of herpetology of the California Academy of Sciences, have returned from a collecting trip through northern California and southern Oregon. The principal object of the trip was to make collections of reptiles, amphibians, and birds' nests and eggs for the academy museum. The trip was made by machine and the party camped out most of the time. Very large collections were obtained.

Mr. E. P. Van Duzee, curator department of entomology of the California Academy of Sciences, is spending the summer in northern California making collections for that department. Dr. Roy E. Dickerson, curator, department of invertebrate paleontology, has been given leave for the remainder of the present calendar year in order that he may take up

certain technical work for the Standard Oil Company.

THE memorial statue of the late Dr. Edward A. Trudeau, founder of the Adirondack Cottage Sanatorium, now known as the Trudeau Sanatorium, Saranac, was unveiled on August 10. The principal oration was made by the Rev. Philemon F. Sturgis. The statue is a gift of former patients of the sanatorium, and bears an inscription indicative of the love and gratitude of the donors.

HENRY GEORGE PLIMMER, F.R.S., professor of comparative pathology in the Imperial College of Science and Technology, London, died on June 22, aged sixty-one years.

DR. NEWELL ARBER, demonstrator in paleobotany at Cambridge, died on June 14 at the age of forty-seven years.

THE deaths are announced of A. Kolisko, of Vienna, professor of pathologic anatomy, and of Leopold Meyer, professor of the diseases of women and children, of the University of Copenhagen.

IT is reported that one of the most complete hospitals in the world, expected to take a large part of the work of rehabilitating American soldiers wounded overseas, is being erected in Detroit by Henry Ford at a cost of three million dollars. The hospital is being built on a twenty-acre tract of land and will have a floor space of 50,000 square feet. It will be a four-story structure, with the exception of the diagnostic building placed in the center, which will be six stories high. There will be 1,300 windows in the building, 40 porches around it, and a roof garden.

BY the will of a Mr. Ramsay, resident in Scotland, but who formerly had large financial interests in Toronto, the hospitals in Toronto and other public charities in that city will benefit to the extent of $750,000.

MCGILL UNIVERSITY HOSPITAL, at Etaples, France, is to be removed to England, as it has been bombed from German airplanes on several occasions.

THE War Department authorizes the statement from the Office of the Surgeon General that, at the request of General Pershing, twenty additional nutrition officers have gone to Europe to supervise rationing of the soldiers of the American Expeditionary Forces and to introduce methods that will further protect the food of the troops from waste, spoilage and contamination. This brings the total of such officers now on duty in England and France to twenty-nine. The first six of these specialists went abroad in March. Their work was so satisfactory that in a few weeks more were asked for. The investigations made by these men resulted in improved mess conditions, both in camp and in the trenches, and demonstrated the necessity for continuous supervision, hence the recent sailing of the twenty. One of the principal problems facing these men is the adjusting of the present garrison ration to current needs. This ration was fixed long before the present conditions of modern warfare, and experience has shown that adjustments must be made in order to feed the troops satisfactorily without waste or spoilage.

THE *Journal* of the American Medical Association states that the leading physicians of São Paulo have organized a society to study questions of heredity and means to improve the human race. Its aims and purposes are set forth in an eight-page pamphlet, especially emphasizing the aim to enlighten and educate the public in matters relating to hygiene and eugenics, for the welfare of the individual, of the community and of future generations.

THE *Royal Geographical Journal* states that M. René de Saussure, great-grandson of the celebrated Swiss naturalist, outlines in the March, 1918, number of the *Archives des Sciences physiques et naturelles* of Geneva, a scheme for a Central Meteorological Bureau for Europe to be established after the war. He suggests that the time is opportune for the foundation of such a bureau, as it would enable the heads of the national meteorological services of belligerent countries to exchange necessary data without direct correspondence. But as he acknowledges that such a central bureau must be under the control of an international committee, this point loses its force, since such a committee must meet before the

bureau can be established. Until the future of the International Meteorological Committee, which has done good work for a generation past, is settled it is quite clear that no step of the kind suggested can profitably be considered. M. de Saussure estimates the annual cost of a central bureau charged with receiving data from stations in all parts of Europe, preparing a daily weather-map, forwarding it by post and telegraphing the data for a provisional map daily, at only 48,000 francs, or less than £2,000. We are sure that such a sum would be totally inadequate for the purpose, even if the bureau were situated, as is suggested, in Switzerland. The greater part of M. de Saussure's paper is taken up with the description of a new method of representing air-movement on maps which he thinks might be adopted in the work of the projected bureau.

THE council of the Society for Practical Astronomy have notified the members and those interested in its work that, by a vote of the council, all further activity of the society, including the publication of the *Monthly Register*, is postponed until after the war. No new members will be admitted, and membership fees for the current year, 1918, will be refunded by the treasurer. Upon resumption of activities, the organization of the society will be the same as it was at the close of 1917, the membership consisting of those who were members in good standing at that time. This decision has been reached after careful deliberation, and in spite of the example set by the scientific societies of our allies. The council feel confident that this step will meet with the unanimous approval of the members. Communications relative to any society matters, and particularly those concerning improvements in reorganization after the war, will be welcomed, and may be addressed to the president, Mr. Latimer J. Wilson, Bausch & Lomb Observatory, Huntington Park, near St. Paul St., Rochester, N. Y., or to the secretary, Lieutenant Horace C. Levinson, 4049 Lake Park Ave., Chicago, Ill.

THE sundry civil appropriation bill, carrying appropriations for the Bureau of Fisheries, became a law on July 1. The principal features of special interest are as follows: *New positions:* One field assistant, $3,000; 1 assistant for developing fisheries and for saving and use of fishery products, $2,400; 1 storekeeper, Pribilof Islands, $1,800; 1 clerk, $1,200 (in lieu of $900); 1 foreman, Bozeman station, $1,200; 1 foreman, Clackamas station, $1,200; 1 superintendent, Key West biological station, $1,800 (in lieu of $1,500); 1 apprentice fish-culturist, Springville station, $600. *Miscellaneous expenses:* Administration $10,000; propagation of food fishes, $400,000 (increase of $25,000); maintenance of vessels, $95,000 (increase of $5,000); inquiry respecting food fishes, $50,000; statistical inquiry, $7,500; Alaska general service, $100,000; protecting sponge fisheries, $3,000. *Special items:* Berkshire trout hatchery, for increasing hatching and rearing facilities, including construction and repair of ponds, improvements to water supply, and for equipment, $2,500; St. Johnsbury station, for establishment of an auxiliary station on Lake Champlain, $5,000; Pribilof Islands, for purchase or construction of power lighter, $20,000.

The Civil Service Commission announces that there are many openings for women as ship draftsmen in the Navy Department at Washington and in navy-yard service throughout the United States. Applications will be received and papers examined at any time, and the applicants who qualify will be offered immediate employment. The pay ranges from $4 to $6.88 per day. The commission lists a total of 13 acceptable forms of training and experience for the four grades into which the register of eligibles will be divided. The applicant may offer either "at least two years' experience in a drafting room, engaged on work of developing plans for buildings or structures involving steel work, architectural work, or mechanical drafting work, or graduation from a course in architecture or mechanical or structural engineering at a college or university of recognized standing" or "graduation from a technical school or college of recognized standing supplemented by a certificate that the applicant has satisfactorily taken and passed a short course in naval architecture

conducted by an institution of learning, one whose regular course is naval architecture and whose special short course in naval architecture referred to above shall have been approved by the commission." The other minimum requirements all include experience in shipbuilding.

The London *Times*, in recording the centenary of the British Institution of Civil Engineers writes: The Institution of Civil Engineers, our premier engineering society and the parent of several other institutions of rather more specialized character, celebrates the centenary of its foundation. It was on January 2, 1818, that it was established by eight young men, who met for that purpose in the Kendal Coffee-house in Fleet Street. It was fortunate in securing as its president, two years after its birth, Thomas Telford, the foremost engineer of his day and one of the leading engineers of all time. Although he was not present at the inaugural meeting, he may fairly be ranked as its founder. Holding the office until his death in 1834, he devoted much of his time during his life to furthering its interests, and at his death bequeathed a sum of money for the establishment of the Telford Medals and Premiums, which have ever since served to encourage the presentation of original communications at its meetings. It was in his time also, in 1828, that its position was established by the grant of a Royal Charter, which contains the famous definition of civil engineering as being:

> The art of directing the Great Sources of Power in Nature for the use and convenience of men, as the means of production and of traffic in states both for external and internal trade, as applied in the construction of roads, bridges, aqueducts, canals, river navigation and docks, for internal intercourse and exchange, and in the construction of ports, harbors, moles, breakwaters and lighthouses, and in the art of navigation by artificial power for the purposes of commerce, and in the construction and adaptation of machinery, and in the drainage of cities and towns.

It is announced from Ottawa that the minister of naval service, controlling fisheries, has decided to close some fourteen lobster hatcheries scattered about the coasts of the Maritime Provinces. The question of lobster hatching has been a subejct of investigation for the past four years. Arrangements are being made to start an educational campaign among the fishermen to induce them to protect all berried lobsters and to cooperate with the department in protecting the fishery and saving the lobster industry.

UNIVERSITY AND EDUCATIONAL NEWS

New York University is endeavoring to raise a fund to meet the emergency war conditions and subscriptions have been received amounting to over $250,000, $94,000 from the alumni of the school of applied science and liberal arts, $89,000 from the professional schools and $67,000 from the undergraduate body on $25 subscription payroll over a period of five years at $5 per year. Part of the plan is to secure an endowment of $500,000 for the engineering school in connection with a cooperative plan of education between the industries and the university. Mr. Mois H. Avram, lecturer on industrial engineering in the university, has been active in this work.

Excavation was started on July 18 for the foundation of the additional building to the University of Nebraska Medical School, Omaha, to be erected at a cost of $150,000. The new building will be four stories in height, red brick and will house the laboratories of pharmacology, physiology and biologic chemistry.

The Secretary of State for the Royal Air Force of Great Britain announces that the sum of £25,000 has been placed at the disposal of the government by Sir Basil Zaharoff, for the purpose of endowing a professorship of aviation. This donation is in continuation of donations previously made by Sir Basil for the foundation of chairs of aviation at the universities of Paris and Petrograd, in order to assist in the progress of aviation among the allies, and it is hoped that the occupants of the chairs will continuously exchange views. It is proposed that the professorship shall be called the Zaharoff professorship of aviation, and that it shall be a professorship of the Uni-

versity of London attached to the Imperial College of Science and Technology.

DUE to the absence of Dean Vaughan in war service, a reorganization of the administration staff of the University of Michigan Medical School has been necessary. The present officers are as follows: dean, Victor C. Vaughan, M.D., LL.D., Colonel, M. C., N. A. (absent on leave); assistant dean, Charles W. Edmunds, A.B., M.D.; acting secretary, Rollo E. McCotter, M.D., and assistant secretary, Ethel Bradley Flick.

THE following new appointments have been made in the various departments of Western Reserve University. In Adelbert College, Webster Godman Simon, A.M., as instructor in mathematics. In the School of Medicine, Carl J. Wiggers, M.D., as professor of physiology. The following promotions have been made in the Dental School: Harold Newton Cole, Ph.D., M.D., assistant professor of dermatology and syphilology; Gaius Elijah Harmon, M.D., C.P.H., assistant professor of hygiene and bacteriology (now senior instructor in hygiene); Bradley Merrill Patten, A.M., Ph.D., assistant professor of sistology and embryology.

IN the Georgetown University Medical School Dr. Clarence R. Dufour, who resigned as clinical professor of diseases of eye and ear, has been appointed emeritus professor; Dr. Isaac S. Stone, professor of gynecology, who resigned after twenty-six years of service, has been succeeded by Dr. J. Thomas Kelly, and Drs. James M. Moser and John A. Foote have been appointed assistant professor of pediatrics.

DR. R. O. CROMWELL, formerly assistant plant pathologist at the experiment station at West Raleigh, North Carolina, has been appointed extension plant pathologist at the Iowa State College of Agriculture and Mechanic Arts, at Ames Iowa.

DR. SAMUEL T. DARLING, of the International Health Board, has been appointed professor of hygiene and director of laboratories in the School of Medicine and Surgery in São Paulo, Brazil.

DISCUSSION AND CORRESPONDENCE

THE CRITERION OF SUBSPECIFIC INTERGRADATION IN VERTEBRATE ZOOLOGY

INTERGRADATION is now generally accepted, both in codes of nomenclature and in practise, as the criterion of zoological subspecies. A second means of determining subspecific relationship, the degree of difference, so strongly advocated by Dr. C. Hart Merriam[1] and others, has been found unsatisfactory; still more so a third, the natural outgrowth of the latter, that of general resemblance, which makes the species practically equal to a subgeneric group. Dr. Ernst Hartert and a few others have employed this last method, but it leads to such evident inaccuracies as treating the American cedar waxwing, *Bombycilla cedrorum*, as a subspecies of the Bohemian waxwing, *Bombycilla garrula*.

What constitutes subspecific intergradation, however, seems still to be debatable, if the diversity of usage among current authors is to be taken as evidence. Briefly stated, there are three ways in which intergradation takes place: (1) By a gradual change over contiguous geographic areas; (2) by an abrupt change in an intermediate area; and (3) by individual variation, whether or not the ranges of the two forms adjoin. The first of these is the kind of intergradation so commonly seen on continental areas where one form passes insensibly into another in the intermediate territory, and is so well-known as not to need illustration. The second is much less common and often results in the presence at certain localities of typical examples of both forms, together with all shades of intermediates; but the only question likely to arise in treating a case of this kind is the allocation of the individuals which occur in such places,—whether they shall be treated all as the one form to which they collectively most approach, or whether the more or less typical examples of each shall be referred to their respective races. The third kind of intergradation, that of individual variation, is of almost as frequent occurrence as

[1] SCIENCE, N. S., V., No. 124, May 14, 1897, pp. 753–758.

the first, and is the sort so often seen on islands, on mountain peaks or other isolated continental areas; and it is this that seems to be at present the debatable kind of intergradation. Shall this be considered equivalent to uninterrupted continental intergradation, or shall it be ignored entirely as intergradation, and the forms so limited be considered distinct species, although some of their individuals may not be distinguishable from those of some other form?

The recent remarks of Mr. H. S. Swarth on the subspecific relationships of certain jays of the genus *Aphelocoma*[2] again brings up this question. A statement of this particular case, which the present writer has already briefly explained,[3] may be of interest in the present connection, since it is typical of the third kind of intergradation. *Aphelocoma californica californica*, *Aphelocoma californica immanis*, and *Aphelocoma californica hypoleuca* are three jays occurring on the Pacific coast from Oregon to southern Lower California, the first two with continuous ranges, the third supposedly isolated. Adjoining *Aphelocoma californica immanis* on the eastern side of the Sierra Nevada, and living sometimes at the same localities, where apparently specifically distinct, is *Aphelocoma californica woodhouseii*. The last, however, ranges eastward to Texas, where it intergrades with *Aphelocoma californica texana*, and through other Mexican subspecies with *Aphelocoma californica sumichrasti* of southern Mexico, the range of which is entirely separate and far removed from any of the races of California or Lower California. Some individuals of *Aphelocoma californica sumichrasti*, however, are difficult, if not impossible, certainly to distinguish from *Aphelocoma californica immanis* or *Aphelocoma californica hypoleuca*.

Mr. Swarth would consider that the individual variation of *Aphelocoma californica sumichrasti* from southern Mexico, which bridges the difference between *Aphelocoma californica immanis* and *Aphelocoma californica hypoleuca*, is not intergradation in a subspecific sense; furthermore, he regards *Aphelocoma californica hypoleuca* from southern Lower California as a distinct species (although he admits that certain examples of *Aphelocoma californica immanis* found in northern California are indistinguishable from this Lower California form) because of the interposition of a darker form of *Aphelocoma californica*, the range of which he considers widely removed, and with which he supposes *Aphelocoma californica hypoleuca* does not geographically intergrade.[4] In such cases the intervening form has the same biological effect as a land or water barrier. Thus the particular point brought out is that intergradation by individual variation is not intergradation in a subspecific sense, and that, therefore, a form to be a subspecies must have a continuous range and merge geographically. With this as the only criterion, all island and isolated alpine forms must be considered distinct species, however slightly and inconstantly they may be differentiated, a view by no means held by zoologists generally.

The principle underlying the use of intergradation as an indication of subspecific relationship and sought to be expressed in nomenclature by a trinomial is that a subspecies is an imperfectly segregated species. Manifestly no form that is a geographic representative of a species is perfectly segregated if any of its normally adult individuals are practically indistinguishable from comparable individuals of another form. We should, therefore, make our nomenclature conform to the facts, not our facts to the nomenclature. In order to do this and satisfactorily to settle the specific status of a number of closely related forms that collectively cover a large geographic area, it is important that we take not only one or two contiguous, but all the forms and their

[2] *Univ. Calif. Publ. Zool.*, XVII., No. 13, February 23, 1918, pp. 406–413; 420–421.

[3] *Condor*, XIX., May, 1917, p. 94.

[4] That *Aphelocoma californica hypoleuca*, as we shall elsewhere explain, proves to have a range practically continuous with *Aphelocoma californica californica* and completely intergrades geographically with the latter, does not affect the principle at present involved.

relations, into consideration. It is evident to any zoologist who has studied large series of specimens of a wide-ranging and plastic species that it is, of course, easy to mistake false for true intergradation, as, for instance, if adults in comparable age and condition are not used in comparison. It is likewise easy to overlook evidence of intergradation, since the latter is sometimes obscured by other circumstances. For example, two forms may meet on the edges of their ranges and intermingle on common ground, remaining perfectly separate and be apparently distinct species, yet elsewhere directly or indirectly through other forms completely intergrade. This is exemplified in our case of *Aphelocoma* by *Aphelocoma californica woodhouseii*, which remains an apparently distinct species where its range meets that of *Aphelocoma californica immanis* at the foot of the Sierra Nevada, but which eastward passes directly by continuous geographic intergradation into *Aphelocoma californica texana*, and thence through forms in eastern Mexico into *Aphelocoma californica sumichrasti*, which in turn intergrades individually with *Aphelocoma californica hypoleuca* and *Aphelocoma californica immanis*. A parallel case is found in the mice of the genus *Peromyscus*, as shown by Mr. W. H. Osgood,[5] in *Peromyscus maniculatus austerus* (Baird) and *Peromyscus maniculatus oreas* Bangs; and also in *Peromyscus maniculatus gambelii* (Baird) and *Peromyscus maniculatus rubidus* Osgood. To consider them species, because at some point where their ranges meet they remain distinct while at another similar place they intergrade, would clearly not best represent the facts.

The use, therefore, of individual variation as one of the chief criterions of intergradation seems not only not illogical but necessary.

Harry C. Oberholser

[5] *North Amer. Fauna*, No. 28, April 17, 1909, pp. 52, 58, 66, 69 and 70.

COTTON AS A SEED CROP

Utilization of cotton seed as a source of oil and other valuable products has brought forward two questions for cotton breeders; first, the possibility of increasing the oil-content in the seeds of lint-bearing varieties; and second, the breeding of a lintless cotton, to be grown strictly as a seed-crop. In asking the first question it is assumed that the oil might be increased without reducing the lint, while the second is prompted by the idea that lintless varieties could be harvested by machinery, thus avoiding the chief difficulty and expense in the production of fiber, the labor of picking the cotton by hand.

Increasing the oil in cotton seed was undertaken several years ago in connection with the breeding of the Trice variety. A large amount of careful work was done by Professor S. M. Bain, of the University of Tennessee, assisted by the late Mr. Albert T. Anders, formerly of the Bureau of Plant Industry, but without finding the definite differences that were sought as the basis of selection for oil-content. The fluctuations induced by conditions of growth or associated with various degrees of maturity attained by the seeds were so large as to conceal inherent differences of individual plants or progenies. As might be expected from the greater proportion of kernel to shell, the oil-content seems to be higher in varieties with large seeds, more than 24 per cent. of oil, or 64 gallons per ton of seed, being reported for the Meade cotton in Georgia, but large-seeded varieties are unpopular because they do not have the highest percentages of lint.

The breeding of lintless varieties might not prove difficult, since individual plants with entirely naked seeds have been found as chance variations in lint-bearing stocks. Degenerate "slick-seeded" plants with little or no fuzz on the seeds and only a sparse covering of lint are of rather common occurrence in the Southeastern States in ordinary short staple fields raised from "gin-run" seed. Some of the inferior "Hindi" variations of the Egyptian type of cotton have nearly naked seeds. Failure to eliminate the Hindi admixture in Egypt damages the crop to the extent of several million dollars every year. A lintless cotton would need to be excluded rigorously from any region where other varieties are grown. The seed must become much more valuable than

it even now is before overtaking the value of the lint, especially in long staple varieties. No compensating increase in the yield of seed is to be expected from a lintless cotton, the fiber being merely cellulose, like the woody tissues of the plant.

Picking a lintless cotton by hand would be out of the question because the seeds fall out as soon as the bolls open, but possibilities of avoiding this difficulty have been suggested by the fact that all varieties do not open the bolls to the same extent or with equal readiness. Certain foreign cottons have nearly indehiscent capsules, as have some of the relatives of cotton, including the okra plant, which could be grown as a seed crop. Other factors that affect the opening of cotton bolls are heat and dryness. Full-grown bolls of Kekchi cotton remained fresh and apparently unchanged for nearly six months in a greenhouse experiment, and yet opened normally when the plants were taken outside and allowed to dry. The failure of bolls to open in cool autumn weather, which now appears as a danger or limiting factor of cotton culture in some parts of California, might be an advantage if harvesting by machinery were practicable.

In considering the possibility of utilizing late-opening cotton in California it seemed that two kinds of machines would be needed. The first machine might be thought of as a modified corn-binder that would cut or pull the plants, and at the same time press and tie them into loose bundles or small bales, not too large to be handled easily nor too dense to dry without rotting. The bundles could be kept rather narrow, since the form of the plants can be controlled by methods of spacing and thinning that have been worked out. The stalks would be in the middle of the bundle, while most of the bolls would be on the outside, so that gradual drying and normal opening might be expected.

As the plants would be pressed flat in the bundles they should come out in convenient shape for running into another machine for picking the seed cotton from the bolls. Relatively slight adaptations of existing types of picking machinery might serve, the problem in this form being much simpler than that of picking cotton from live plants in the field, which many inventors have attempted to solve. Gumming of the machinery and staining of the fiber with the plant juices would be avoided, as well as the difficulties of operating and repairing very complicated machines in the field.

That machine picking could produce grades equal to those of cotton picked carefully by hand is hardly to be expected, although the quality might not be seriously impaired, if admixture with weak, immature fiber can be avoided. This might be possible in parts of California where the bolls are not likely to be frozen, though the leaves may be killed.

Cleaners and gins could be operated in connection with stationary picking machines, and utilization of the stalks for paper-making or other industrial purposes would become more feasible. Leaving the fields clear at the end of the season would facilitate the planting of other crops, and might have advantages in relation to pests or diseases. Even with cotton considered as a seed-crop, the possibilities of mechanical harvesting do not appear to depend upon the breeding of lintless varieties. Special characters, conditions, or appliances that might be expected to facilitate the harvesting of lintless cotton seem likely to be more useful in connection with lint-bearing varieties.

O. F. COOK

BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE

AN ASPECT OF THE RELATION BETWEEN ABUNDANCE, MIGRATION AND RANGE IN BIRDS

THE steps by which a species of bird extends its range or acquires specialized migratory habits are not known. They present problems of interest in themselves and wide bearing in other fields. The aspect of the matter here set down is at least worthy of consideration.

The red-breasted nuthatch is a bird which breeds in the northern coniferous forests. Some years it sweeps south across the country in fall in considerable numbers, and it is ex-

ceptional when some are not to be found in fall and winter in favorable localities in our latitude. A comparatively small number are seen returning the following spring, often accompanying flocks of north-bound warblers. This past season is remarkable in that practically none came south. Two circumstances that have come to my attention have a significant bearing on this fact. In late winter at a locality on Long Island where the species can generally be found and it was absent, chickadees were observed feeding on pine seeds, one of the nuthatch's favorite foods, showing that it would have fared well had it been present. Also, in the preceding summer, observers who visited the southern edge of its breeding range found it unusually scarce.

We may place the movement of the red-breasted nuthatch with what I shall call centrifugal migrations. Species which possess such, of which there are a number of good examples, periodically attain a great abundance in their permanent range, and then sweep outward, as it were in waves. For purposes of discussion I will mention three other types of birds. The white-breasted nuthatch which occupies a broad area to the south of its red-breasted cousin, has, so far as is apparent, no migration. The song sparrow, although always present over a large part of its range, has a very definite intraspecific migration, and many species have what I shall call a centripetal migration, that is, they return from the distant south to breed each year in a definite northern area usually unsuitable to their permanent occupancy.

The centrifugal type of migration is notable for two things, its futility and its wastefulness. By futility I mean that species do not seem to increase their permanent range by that method; rather, periods of abundance and migration are followed by periods of scarcity even in that range. Data enough has been gathered to at least partially explain this. Individuals swept south by the wave seem not to have the definite migration instinct which causes centripetal migrants to return to their identical nesting localities over zones of latitude. One or more instances are at hand of the red-breasted nuthatch remaining to breed in southeastern Massachusetts where (in the Cape Cod region) it becomes especially numerous during its incursions, perhaps from the abundance of its favorite pine seeds. Yet it is probably too much of a wanderer ever to establish a permanent colony there, even if the environment were satisfactory. Probably the majority of any wave of centrifugal migrants is utterly dissipated and lost, and a small minority find their way back to their permanent range. In fact there is little to be said in favor of centrifugal migration except that it is expedient, in fact the exigencies of the case may demand it.

I will now enter a little further into the realms of hypothesis and present the most plausible view of the sequence of migrations. The centrifugal condition is the original one, with the species in a state of unstable abundance, followed by the elimination of centrifugal migrants and the permanent resident condition typified by the white-breasted nuthatch, where the species is sufficiently adjusted to conditions to maintain itself in unvarying though comparatively small numbers. The migratory tendency now begins to express itself in a definite way among the individuals, many of which have definite breeding and winter localities, the former perhaps (in the case of the song sparrow) in some garden, the latter in some swamp. The tendency is for these two localities to become separated by greater and greater distances of latitude until we have a well-marked intraspecific migration.

As this process goes forward the range of a species may well break in the middle, leaving a centripetal migration in which highly developed homing instincts in the individual bird take the place of the futile centrifugal "wanderlust" of the race in its initial condition. The maximum ability to colonize and expand would come with the stage in which the individual had a definite migratory instinct to adjust to the season and yet was sufficiently a permanent resident to "hang on" in a good locality against adverse circumstances, a condition to my mind approximated among familiar species by the song sparrow, which has at

this time considerable abundance over an unusually extensive range. Also birds with the greatest development of centripetal migration, though often exceedingly abundant, are perhaps less resistant than others. Of the shore birds which formerly thronged our coast, the greater yellowlegs, whose summer and winter ranges were not so widely separated, has held out best against the inroads of gunners, while the Eskimo curlew and golden plover with the longest migration routes, have suffered most severely.

The above aspect of the situation may be of interest to the student of fluctuating population and political complications arising therefrom as well as to the student of bird migration. The fact seems to be that in nature a species adjusted to maintain its numbers constant even though comparatively small, is in a more advantageous position than one in which there is a rapid increase of numbers necessitating migrations beyond the capabilities of the individuals.

J. T. Nichols

New York City

QUOTATIONS

THE ROCKEFELLER FOUNDATION

The Rockefeller Foundation in New York is a conspicuous example of modern philanthropic effort. Owing its existence and its maintenance to the enlightened liberality of Mr. John D. Rockefeller, it is conducted on business lines without the appeals to public benevolence which, in the absence of state endowment, are generally necessary to procure the funds required for the successful prosecution of charitable enterprises. A review of the work done by the foundation in 1917 for various purposes connected with the war, and in regard to public health and medical education, recently issued by the president, Mr. George E. Vincent (New York, 1918) states that at the end of 1917 the principal fund had a market value of about £21,000,000; the income of that fund for the year was £1,430,770. To this were added a balance carried over from 1916, a gift by Mr. Rockefeller of £1,100,000, and the sum of £1,000,000 voted by the trustees from the principal fund. The cash balance carried forward into the year 1918 was £23,325,809, but all except £254,267 of this amount will be needed to meet appropriations and pledges for the next fiscal year. The foundation is at present devoting by far the greater part of its available resources to the support of war work. When the United States joined in the great struggle the foundation placed a large sum at the disposal of the American Red Cross, which has undertaken comprehensive schemes of relief for the allied armies and the civilian population of the invaded countries. The only work which it is now directly administering in Europe is an antituberculosis campaign in France. The American government from the first insisted that the training camps were to be regarded as educational institutions. Official commissions and national and local societies worked together in providing within and outside camps comfort, recreation, social entertainment, educational opportunities, and moral safeguards for the troops. To nearly all the units that make up this vast cooperation the foundation has given sums amounting in the aggregate to £900,000. In 1917 a portable military base hospital was erected in the grounds of the Rockefeller Institute for Medical Research, embodying the features which British and French experience has proved to be essential. In this hospital the Carrel-Dakin method of sterilizing wounds is being demonstrated. To the hospital and the laboratories medical officers of the army and navy are being sent for study and experience. The foundation has undertaken the making of serums and their distribution to government hospitals. Funds are being provided to help the Surgeon-General in engaging specialists for the treatment and hospital care of nervous and mental diseases due to the war. Contributions were also made for the after-care of the victims of infantile paralysis in the epidemic in New York in 1916. In 1915 the foundation offered to bear the cost of establishing and maintaining as a part of Johns Hopkins Hospital a school of hygiene and public health. During 1917–18 a staff was recruited and lines of work laid down. Dr. William H. Welch resigned

his professorship in Johns Hopkins to become director of the new institution. During 1917 steady progress was made in campaigns against hookworm, malaria and yellow fever, in promoting better health administration, in securing reform in sanitary legislation, in persuading governments to increase their expenditure for preventive medicine, and in encouraging public health education. In China the foundation is promoting modern medical education and hospital administration. In September last the Chinese Minister of Education laid the corner stone of the Peking Union Medical College, which is being built in the Chinese capital. The program also includes a medical school and hospital at Shanghai, but the war has interrupted the prosecution of this scheme. The growth of the Rockefeller Institute for Medical Research has called for increasing sums for equipment and current expenses, and £400,000 was appropriated during 1917 as an addition to its endowment.—*British Medical Journal*.

SCIENTIFIC BOOKS

Fresh-water Biology. By Henry Baldwin Ward and George Chandler Whipple, with the collaboration of a staff of specialists. New York, John Wiley & Sons. 1918. 8vo. 1111 pp., 1547 figures in text.

At last American students of fresh-water life are provided with a handbook and guide that will enable them to acquaint themselves with the forms of life found in their native lakes, ponds and streams. Ward and Whipple are the editors, and they themselves contribute five of the thirty-one chapters. Ward writes the general introduction and two chapters on parasitic worms, and one on Gasterotricha, and Whipple writes the concluding chapter on Technical and Sanitary Problems. There are two further introductory chapters, one by Shelford on conditions of existence, and an altogether excellent and practical chapter by Reighard on methods of collecting and photographing. The remaining chapters discuss the principal groups of aquatic organisms and are written by well-known American specialists in the several groups. All are prepared with evident care and with due regard for the needs of the general student and all are adequately illustrated.

Three of these chapters are for reading purposes only—the ones on bacteria by Jordan, on the higher plants by Pond and on aquatic vertebrates by Eigenmann. These are excellent summarized statements of the chief biological phenomena of these groups and are most interesting reading.

The volume is much more than a text-book for the remaining groups (to which 26 chapters are devoted): it is a handbook and guide. and a means of identification, and this is its peculiar merit. Each chapter gives, besides an introductory account of the group, an illustrated key, that is adequate for the determination of the forms and that is convenient and workable. No such set of keys has hitherto been available anywhere. The clear and copious illustrations are placed alongside the reading matter relating to them in the text, and are adequate for the interpretation of the characters used.

This book will at once take its place as the most indispensable reference work for students of freshwater biology; and it is likely to hold that place for a long time.

James G. Needham

Equidæ of the Oligocene, Miocene and Pliocene of North America. By Henry Fairfield Osborn. Memoirs of the American Museum of Natural History, Volume II., Part I., issued June 10, 1918.

An extensive memoir of two hundred and seventeen quarto pages, illustrated by one hundred and seventy-three figures, and fifty-four plates reviews our knowledge, from a systematic standpoint, of the "Equidæ of the Oligocene, Miocene and Pliocene of North America."

The present revision of the fossil horses "is *iconographic* in the sense that all the original type figures of authors are reproduced in *facsimile*, and all unfigured types, especially those of Marsh, are now figured for the first time. . . ." The work is based largely on the collections at Yale and at the American Mu-

seum of Natural History, but a use was also made of type material in other collections.

Osborn's idea in presenting the matter in this form is that "the permanent data of systematic paleontology are the *type specimens*, determinate or indeterminate, the *type locality*, the *type geologic level*. Descriptions, figures, opinions, inferences, phylogenetic and other speculations are subject always to the fallibility of human observation and interpretation." These ideas of course are fundamental and apply to other phases of paleontology than the systematic portion.

A full discussion of the "Genesis and Evolution of Single Dental Characters" is given with abundant illustrations. This is followed by a review of "Geologic Horizons and Life Zones" appropriately illustrated with maps and tables.

The systematic portion discusses one hundred and forty-six species distributed among ten genera. Each species is carefully discussed and the type material illustrated. On turning the pages one is struck by the fragmentary nature of many of the species—but this is the condition throughout all fossil vertebrate groups. To some of the species more information has been added since their description but many of them stand to-day as they were originally described. Many species are known from very complete material.

The contribution is one of which American paleontologists may well be proud. Its permanent character is the careful collection and assembling of data on all species of fossil horses known from the Oligocene to the Pliocene of North America. The magnitude of the task is almost appalling in the amount of detailed work involved. The author tells us that this is a portion of the work done in connection with his "Monograph of the Equidæ" on which he has been working for the last eighteen years. A portion of the present work is due to the collaboration of Dr. W. D. Matthew to whom the author gives full credit.

The high standard assumed by the publications of the American Museum of Natural History twenty-five years ago is maintained in the present memoir. The typography and illustrations are excellent.

Roy L. Moodie
College of Medicine,
University of Illinois

SPECIAL ARTICLES

NOTE ON MEASURING THE RELATIVE RATES OF LIFE PROCESSES

The development of quantitative methods in biology depends largely on finding means of measuring the speed of life processes. In most cases the absolute rate is of less importance than the relative rate (*e. g.*, the normal velocity compared with that observed under the influence of a reagent). Examination of the literature shows that the determination of relative rates is frequently made in a faulty manner, which could easily be avoided by a slight change of method.

We may illustrate this by supposing that the life process in question is a chemical one. The rate of a chemical reaction is expressed by its velocity constant. The simplest case is that in which a single substance, A, decomposes. The usual equation is[1]

$$K = \frac{1}{T}\log\left[\frac{A}{A-X}\right],$$

in which K is the velocity constant, T is time and $A-X$ is the amount remaining at any given time, T.

When the reaction is half completed the value of $A \div (A-X)$ is always 2, no matter what the original concentration of A. The time required to reach this stage of the reaction is inversely proportional to the value of K: for it is evident that if we double the value of K we must halve the value of T, provided the value of $A \div (A-X)$ remains 2, or any other constant value. Hence we see that no matter what stage of the reaction we choose (half completed, one fourth completed, etc.) the velocity constants are inversely pro-

[1] Natural logarithms give the true value of k, but common logarithms are frequently used: these multiply the value of k by .4343. For illustrations of the application of this equation to life processes see Osterhout, W. J. V., Science, N. S., 39: 544, 1914; *Jour. of Biol. Chem.*, 21: 585, 1917; *Proc. Nat. Acad. Sciences*, 4: 85, 1918.

portional to the times required to bring the reacton to the same stage.

This holds not only for reactions of the first order (where a single substance decomposes) but for reactions of higher orders (where two or more substances combine) as well as for consecutive reactions[2] and autocatalysis.[3]

It follows that when a chemical process proceeds at different rates under different conditions, we can compare the velocity constants by simply taking the reciprocals of the times required to bring the reaction to the same stage. If we merely wish to know the relative rates (as is usually the case in biology) it is not necessary to determine the velocity constants at all.

Whenever the initial conditions are the same with respect to concentration we need only compare the times required for equal amounts of work, since these bring the reaction to the same stage.

If on the other hand one attempts to arrive at the relative rate by comparing the amounts of work performed in equal times (as is frequently done in biological research) he can easily fall into serious error. This is evident from Fig. 1, which shows the curves of a reaction proceeding at two different rates, the velocity constant of *B* being twice as great as that of *A*. It is evident that the abscissa of *A* at any point is just twice that of *B* while no such relation obtains among the ordinates.[4] For example at the point *C* the ordinate of *B* is twice as great as that of *A*, while at the point *D* it is only 1.1 times that of *B*. Hence it is evident that we should compare abscissæ rather than ordinates (*i. e.*, times required to do equal amounts of work rather than amounts of work performed in equal times).

This principle will also be found to apply to a variety of physical processes.

The principle is sufficiently obvious where successive determinations are made and curves are drawn. But there is a common type of

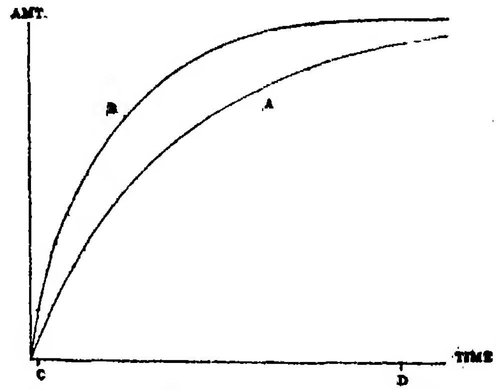


FIG. 1. Curves showing the same process proceeding at different rates one of which, *B*, is twice as rapid as the other, *A*.

experimentation in which, for various reasons, a single observation at one rate is compared with a single observation at another rate. The principle in question is then easily overlooked. In some cases this leads to serious errors.

If we wish to compare the normal rate of a biological process with an abnormal rate (*e. g.*, under the influence of a reagent) it is evident that we can use this principle, but the method of application will depend on circumstances. The normal rate may be constant and its graph a straight line. If this is also true of the abnormal rate it will make no difference whether we compare times or amounts of work.

When the abnormal rate is variable we may have the condition shown in Fig. 2. The normal rate *E* is constant: the variable abnormal rate *F* at any point such as *H* may be determined by drawing the tangent at that point and taking the ratio $J \div K$.

In many cases it is not possible to secure data for drawing directly such a curve as that shown in Fig. 2. We may, however, deter-

[2] The principle holds for consecutive reactions in case all the constants are multiplied by the same factor, otherwise not. *Cf.* Osterhout, W. J. V., *Jour. Biol. Chem.*, 32: 23, 1917

[3] *Cf.* Mellor, J. W., "Chemical Statics and Dynamics," p. 291, 1909.

[4] We can not avoid the difficulty by comparing the rates of the two processes at a given time; for the rates so obtained will bear no constant ratio to each other. Only when they are compared at the same stage of the reaction will they show a constant relation; this gives the relation between the velocity constants.

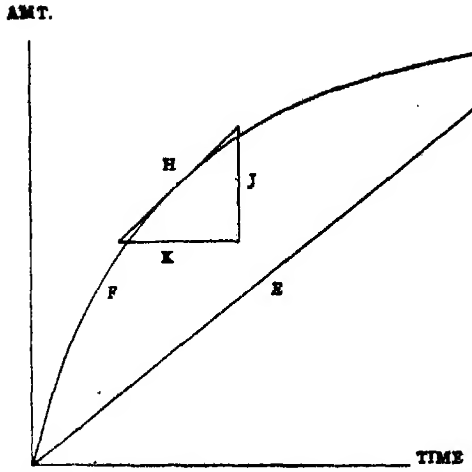


FIG. 2. Curves of a normal biological process E proceeding at a constant rate, and the same process under abnormal conditions with a variable rate, F.

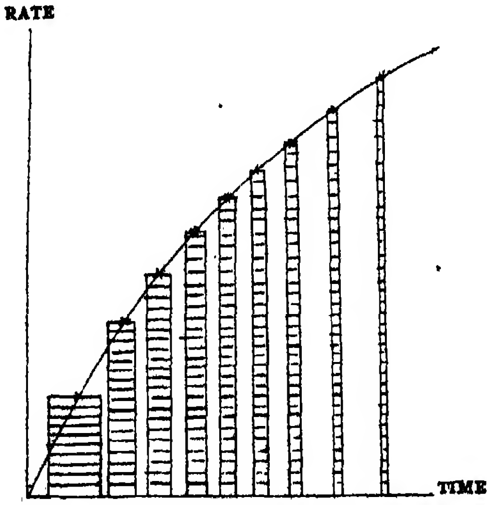


FIG. 3. Curve of a biological process which is studied by measurements of its rate made at frequent intervals. The shaded portions represent periods during which measurements are made. The unshaded portions represent intervals during which there are no measurements.

mine the rate at various periods as shown in Fig. 3, in which the periods during which the rate is measured are shaded while the intervals during which no measurements are made are unshaded.

We can determine the time necessary to perform a given amount of work and take its reciprocal as the rate: this rate is of course an average for the whole period. If the rate is changing during the period the average rate probably occurs near the middle of the period; hence we may place the ordinate representing the rate in the middle of the period as shown in the figure. The resulting curve can be transformed into a curve of the type shown in Fig. 2 by finding the total amount of work performed at any given time: this is accomplished by finding the area enclosed by the curve and the ordinate of the time chosen (since this area is the product of rate by time, it gives the amount of work performed).

Summary.—Measurements of the relative rates of biological processes are frequently made in a faulty manner which may easily be avoided by a slight change of method.

Usually it is preferable to compare the times required to perform a given amount of work (or to bring the reaction to the same stage) rather than to compare the amounts of work performed in a given time.

W. J. V. OSTERHOUT

LABORATORY OF PLANT PHYSIOLOGY,
HARVARD UNIVERSITY

HOW FOOD AND EXERCISE INCREASE OXIDATION IN THE BODY

LAVOISIER,[1] shortly after his discovery that oxygen supported combustion, showed that physical work increased oxidation in the body, thus giving rise to the energy for the work. He also found that the ingestion of food increased oxidation. Rubner[2] showed that of the food-stuffs, meat increased oxidation most, fat next, and sugar least. The present investigation was begun in an attempt to find out how physical work and the ingestion of food increase oxidation in the body.[3] We had already found that whatever increased oxidation in the body also stimulated the liver to an increased output of catalase, an enzyme

[1] Lavoisier, *Mem. de l'Acad. des Sc.*, 1780.

[2] Rubner, "Energiegesetze," 322.

[3] Burge, Neill and Ashman, *American Journal of Physiology*, Vol. XLV., No. 4, pp. 388–395, 500–506.

in the tissues possessing the property of liberating oxygen from hydrogen peroxide. Hence the conclusion was drawn that catalase is the enzyme in the body principally responsible for oxidation. Stated more specifically, the present investigation was carried out to determine if the end products of digestion of food, when absorbed from the alimentary tract and carried to the liver, stimulate this organ to an increased output of catalase, which being taken to the muscles and tissues increase oxidation, and if during exercise the liver was also stimulated to an increased output of catalase, thereby increasing oxidation in the muscles and thus furnish the energy for exercise.

The animals used were cats, rabbits and dogs. The catalase in 0.5 c.c. of the blood of the animals was determined by adding this amount of blood to hydrogen peroxide in a bottle at 22° C. and as the oxygen gas was liberated, it was conducted through a rubber tube to an inverted burette previously filled with water. After the volume of gas thus collected in ten minutes had been reduced to standard atmospheric pressure, the resulting volume was taken as a measure of the amount of catalase in the 0.5 c.c. of blood. The material was shaken at a fixed rate of one hundred and eighty double shakes per minute during the determinations. The animals were exercised in a tread-wheel seven feet in diameter and two feet wide. The food materials were carbohydrates (maltose, levulose, dextrose, lactose, honey, cane sugar, cornstarch, dextrin, wheat flour, corn meal, rice flour and fruits (oranges, lemons, apples, bananas, grape-bean flour); fats (olive oil, bacon, cream, cod-liver oil, glycerine, palmitic acid and lard); fruit and rhubarb); proteins (egg, beef, beef extract, beef juice, aminoids and peptone); beverages (coffee, milk, chocolate, tea and cocoa).

The catalase of the blood of the animals was determined before as well as at fixed intervals after the introduction of the food materials. It was found that the ingestion of the simple sugars, dextrose, etc., increased the catalase of the blood very quickly and in some cases as much as 40 per cent. above the normal. The starchy foods, flour, etc., increased the catalase of the blood, but not so quickly as did the simple sugars. The quicker action of the simple sugars was attributed to the fact that these substances are absorbed immediately and taken to the liver, whereas the starchy foods had to be digested before absorption. Proof that the simple sugars increase the catalase of the blood by stimulating the digestive glands, particularly the liver, to an increased output of catalase, is offered in the following experiment. After etherizing a dog, the abdominal wall was opened and the liver exposed. A comparison was made of the amount of catalase in the blood taken directly from the liver with the amount of blood coming from the tissues, that in the blood of the jugular vein, for example. The blood in the liver or coming directly from the liver was always found to be richer in catalase by 15 to 20 per cent. than the blood taken from any other part of the body. This comparison was made in a great number of animals and is taken to mean that the liver is continually replenishing the catalase of the blood which is being continually used up in the oxidative processes of the tissues. After introducing a simple sugar, such as dextrose, into the etherized animal with its abdominal wall opened, the catalase of the blood taken from the liver was increased much more extensively and rapidly than the blood from a vein such as the jugular. This observation is interpreted to mean that after absorption the sugar was taken to the liver and stimulated this organ to an increased output of catalase. The end products of digestion of the other food-stuffs were tried in a similar manner and all these substances were found to stimulate the liver to an increased output of catalase, meat digest being most effective, fat next, and sugar least.

Of the fats both the olive oil and bacon produced a very quick and pronounced increase in the catalase of the blood, whereas the cream, lard and butter did not act so quickly, due presumably to their slower absorption from the alimentary tract. Coffee, milk, cocoa and tea did not produce an appreciable increase in catalase, while chocolate did. The

stimulating effect of chocolate was attributed to the high fat content of this beverage. Very ripe fruit increased the catalase of the blood quickly and extensively, while less ripe fruit did not. This was attributed to the fact that the very ripe fruit contained much sugar, which was quickly absorbed, taken to the liver, and stimulated this organ to an increased output of catalase, whereas the less ripe fruit contained less sugar and hence did not stimulate the liver so strongly. The meat digest increased the catalase of the blood very quickly and extensively, whereas meat, eaten as such, did not act so quickly, due presumably to the time taken for digestion. The meat extract and beef juice produced a small increase in catalase.

Dogs were used in studying the effect of moderate exercise on catalase. The animal was placed in a treadwheel and by a little coaxing was induced to run and thus turn the the wheel at a rate of about five miles per hour. The catalase in 0.5 c.c. of blood taken from the external jugular was determined before the exercise as well as at 15-minute intervals during the exercise. It was found that the effect of moderate exercise was to increase the catalase of the blood from 15 to 20 per cent. in most of the dogs used.

Domestic rabbits were used in studying the effect of strenous exercise and fatigue on catalase. The rabbits were also placed in the wheel, which was turned slowly by hand so that the direction in which the wheel was rotated could be changed to suit the direction in which the rabbit took a notion to run. A few slow turns of the wheel was sufficient to tire and fatigue the rabbit. Every precaution was taken not to abuse or injure the animal in any way. It was found that the strenuous exercise and fatigue decreased the catalase of the blood in some cases by as much as 30 per cent. and that during rest for an hour, the catalase returned to the normal amount and in fact above normal in several instances.

We had already shown that the output of catalase from the liver was increased by stimulating electrically the nerves (splanchnics) distributed to the liver. The explanation that suggested itself for the increase in catalase during moderate exercise was the stimulation of the liver over the splanchnics to an increased output of this enzyme, while the decrease in catalase during violent exercise and fatigue was due to the using up of catalase in the oxidative processes of the muscles more rapidly than it was being replenished by the liver. The increase in catalase during the periods of rest after hard exercise was attributed to the fact that the liver was putting out catalase in the blood more rapidly that it was being used up in the muscles.

According to the chemical theory as set forth by Ranke,[4] fatigue is due to the accumulation of substances, acid in nature, such as lactic acid, which inhibits or depresses the power of the muscles to contract. It is recognized that the accumulation of these acid substances is due to incomplete or defective oxidation. The decrease in catalase observed in the experiments reported in this paper is offered as the cause for the defective oxidation during hard muscular work and fatigue while the helpful effect of moderate exercise is attributed, in part at least, to the increase in catalase produced in this type of exercise.

From the experiments reported in this paper, the conclusion is drawn that food and exercise produce an increase in catalase with resulting increase in oxidation by stimulating the liver to an increased output of this enzyme.

W. E. Burge

Physiological Laboratory of the University of Illinois

[4] Ranke, "Tetanus," Leipzig, 1865.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, AUGUST 23, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

AMERICAN BOTANY AND THE GREAT WAR

THAT botany, the traditional *scientia amabilis*, should have a place in the present world war, seems almost a contradiction in terms. Yet so far are we from the days when war was the concern of professional soldiers only, that one of the earliest announced requests of the British war commission was for regiments of foresters, who are first of all botanists, for service in the forests of France.

That the activities of all professional botanists should, moreover, be profoundly influenced by the war was inevitable. Botany like other sciences is international. Before the war Germany held a prominent and unique place in the botanical world. A number of American students of botany were trained in her laboratories, and although within the last decade the emigration of American students to Germany had slackened, it was the war which effectually stopped the current.

Germany held moreover an almost complete monopoly of the publication of abstracts of botanical papers. Botanists had come to take it as a matter of course that botanical abstracts would appear in German publications, and two at least of these abstract journals had attained world-wide circulation and prestige. These abstract journals are, of course, no longer available in America, if indeed they are being published. It is natural that in this particular field, now left vacant, American botanists should begin to extend their activities and it is gratifying to note that, at their last annual meeting (January, 1918), the members of the various American botanical societies inaugurated the publication of such a journal under editorship which guarantees its success.

In incidental, and somewhat unexpected, ways the war has influenced botanical studies. The shortage of potash has stimulated the

study of kelps, and the culture of these and other marine algæ; while the increased consumption and rising price of coal has led to the reopening of at least one abandoned mine which has yielded fossil plants of great scientific interest in the past and will be closely watched by paleobotanists this summer. The recently recognized value of certain species of sphagnum moss (especially *Sphagnum papillosum* and *S. palustre*) as a substitute for absorbent cotton for use in surgical dressings has enabled the very few botanists who are familiar with this rather difficult genus to render important service to the Red Cross by exploring the sphagnum resources of the country and by advising local Red Cross chapters in their efforts to locate new sources of supply.

Undoubtedly the most striking effect of the great war on American botanists has been to direct their attention more generally than ever before to problems of plant pathology. The food situation, accompanied by the educational campaign of the Food Administration and Department of Agriculture, directed popular attention to the basic fact that humanity is, in the last analysis, directly dependent on green plants for food. Statements that we "must save wheat for our allies" lent new interest to the fact that stinking smut of wheat annually costs the United States twenty-two million bushels. Urgent advice that we must use perishable fruits and vegetables to save more concentrated foods for the armies in France called public attention sharply to the fact that fresh fruits and vegetables can not easily be shipped great distances, that they are in truth highly perishable; and finally to the tragic fact that large amounts are annually lost in transit and on the market.

With this increased popular interest went a renewed realization on the part of botanists themselves of the fundamental importance of their work and of their own responsibility in such matters. They knew that stinking smut was preventable and the means of its prevention. They realized the immediate necessity, military necessity even, that it be prevented. With state and federal agencies calling attention to the need for increased utilization of fruits and vegetables came the realization that five to ten per cent. of our eighty million dollar apple crop is destroyed by diseases the control of which is well understood and aroused the determination that they should in fact be controlled.

The case of losses which occur on the market was not so simple. The methods of control of plant diseases which cause losses of fruits and vegetables in transit have been worked out in a few instances, whereas about others very little is known. The obligation, however, was equally apparent, so far as methods of control were known they must be applied, where none were known they must be found.

With such a task before them it is not surprising that American botanists have organized as never before and as a result this summer is seeing a campaign for the control of plant diseases never approached in this country. With this there is being carried on an increased amount of research on fundamental scientific questions of significance in the control of plant disease.

This increased usefulness is being brought about by better organization of the men already engaged in the work and by much outside assistance from botanists who are not, professionally, plant pathologists. Both these changes would, indeed, have been necessary in order to keep up even the normal activities in plant pathology, for the number of workers in this line, as in all lines, has been reduced by the needs of the army and navy. The younger men and in particular the graduate students preparing for work in plant pathology have enlisted in large numbers.

The organization of American botanists for greater service in the study and control of plant diseases is under the immediate direction of the War Board of American Pathologists, a representative committee appointed by the American Phytopathological Society, at its annual meeting, January, 1918. The work which this committee has already accomplished is too varied to be detailed. Three phases of its activity will sufficiently illustrate the scope and methods of its work. These are the man power census, the extension work, and the assistance of research.

A reorganization of man power, if much was

to be accomplished, was rendered absolutely necessary by the inroads due to enlistment for military service. The first step in this direction was taken by the man power census. A brief questionnaire was sent to every botanist in America, who could be reached, and on this card each man was requested to indicate his training, degree of availability and willingness to take up emergency work in plant pathology. The replies have been most gratifying in number and tone. Teachers of botany and investigators in other fields have in considerable numbers indicated a willingness to lay aside temporarily their own investigations, investigations usually of great importance to the progress of botanical science, and take up work on the control of plant diseases.

The aim of the extension work of the committee is to make available everywhere in America information now available anywhere in America. Pathologists in various states were asked to contribute any information they might have, published or unpublished, which might be of service in other sections. Responses to this request also have been prompt and enthusiastic. Pathologists all over the country have placed in the hands of the committee for general distribution information which they have acquired in their own work and which seemed likely to be useful to other workers. They have done this frequently without waiting to insure credit to themselves by prior publication. Instead of safety first they have placed service first.

In research the effort has been to call attention to those problems which were of most pressing importance and to coordinate the work of investigators in different regions. Much has been accomplished here in so arranging work that the efforts of one investigator should supplement rather than duplicate those of his neighbor.

The results of these lines of effort can not fail to be of great service. Undoubtedly the greatest immediate gain will come from the extension work, from the distribution of information to the plant pathologists of every state in the union and the further distribution of this information through the county agents and the farm demonstrators to the actual producers. It is highly probable, however, that the greatest ultimate good to plant pathology as a science and to the nation will come from the temporary enlistment of a large number of botanists from other lines. This increase is not a gain in numbers merely but a gain in different technical training, different methods of work, new points of view. So close are the interrelations of the natural sciences that striking contributions to a science are frequently made by a newcomer in the field who has been well trained in another not too closely related field. Thus it is only natural to expect that from the present mobilization of botanists of all kinds in plant pathology will come striking and valuable contributions to that science.

Neil E. Stevens

Bureau of Plant Industry,
Washington, D. C.

A SURVEY OF HIGH-SCHOOL CHEMISTRY IN PENNSYLVANIA

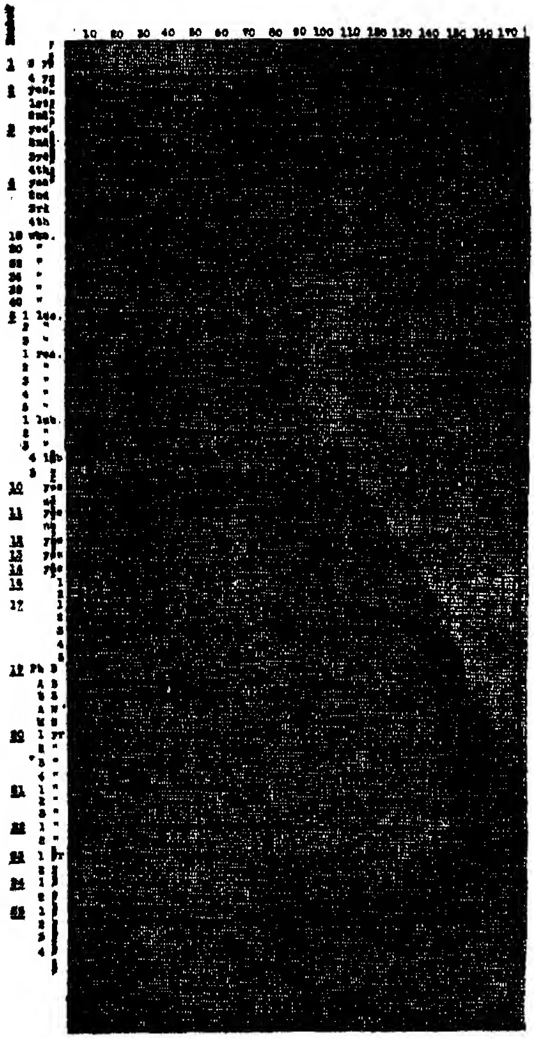
For the purpose of establishing a relationship between high-school and college chemistry, the writer sent the following information blank to the 971 high schools of Pennsylvania, following the original communication by a second request.

Name of high or preparatory school ....
Location .... St., City ...... State ......
Name of officer making this report ....
Official Title ....

1. Do you require a three- or four-year course for graduation: .... year.
2. Do you give a course in general science? ...... In which year is it taught? ....
3. Do you give a course in physics? .... In which year is it taught? ....
*4. Do you offer a course in general inorganic chemistry? .... In which year is it taught? ...... How many weeks? ...... How many pupils take the course? ....
5. How many lecture periods per week? .... Length of period? .... How many recitation periods per week? .... Length of period? .... How many laboratory periods per week? ....

* If you offer more than one couse, furnish statistics for the one considered your college preparatory course and mention the other under 14.

Length of period? ....
How many pupils in a recitation section? .... In a laboratory section? ....
How many recitation sections? ....
How many laboratory sections? ....
How many pupils per instructor in laboratory sections? ....



6. Text book employed? ....
7. Laboratory manual employed? ....
   Do you omit any of the experiments? ......
   Which ones? ....
8. Chemical elements studied in course? (Cross out those not studied.) O, H, N, Cl, C, S, F, Br, I, P, B, As, Si, Sb, Bi, Na, K, Ba, Sr, Ca, Cu, Ag, Au, Mg, Zn, Cd, Hg, Al, Sn, Pb, Cr, Mn, Fe, Co, Ni, Ra.
   Do you include any not listed above? ......
9. Which of the following do you include? (Cross out any not included.) Dalton's atomic theory, law of constant proportions, combining weights, valence, Boyle's law, kinetic molecular hypothesis, Avogardo's law, Gay-Lussac's law, catalytic agent, allotropism, osmotic pressure, freezing and boiling point effects, gram molecular volume law, DuLong and Petit's law, periodic arrangement of elements, Mosely numbers, electron theory, structure of atom, ionization, Faraday's law, equilibrium, thermal equation, colloids.

   Mention laws or theories taught and not included in above list ....
10. Do you think that it is an advantage to have physics precede chemistry? ....
11. Do you consider it wise to postpone chemistry to the *fourth* year, giving physics in the third, and mathematics during all four? ..
    ....
12. Do you offer a course in qualitative analysis? ...... Nature and scope of work? ......
    ....
    ....
    ...... Text book? ....
13. Do you offer a course in organic chemistry? .... Nature and scope of work? ....
    Text book? ....
    ....
14. Do you offer any other courses in chemistry? .... Nature and scope? .....
    ....
    ....
    ......Text book? ....
    ....
15. (*a*) How many hours do you lecture personally per week? ....
    (*b*) How many hours of recitation do you conduct personally per week?........
    (*c*) How many hours of laboratory work do you give personally per week? ......
    ....
16. If you have assistants how many and in which part of the work? ....
17. Do you teach any subjects other than chemistry? If so mention the subjects and number of hours per week? ....
    ....
    ....
18. Colleges or universities which you have attended ....
    ....

....

19. Degrees and when obtained? ....

....

20. Did you study inorganic chemistry in college? .... How many years? ....
21. Did you study quantitative analysis? .... How many years? ....
22. Did you study qualitative analysis? .... How many years? ....
23. Did you study organic chemistry? .... How many years? ....
24. Did you study physical chemistry? .... How many years? ....
25. Did you study physics? .... How many years? ....

TABLE I

Number of Pupils taking College Preparatory Course in General Chemistry

Number of Pupils	Number of Schools	Number of Pupils	Number of Schools	Number of Pupils	Number of Schools
3	1	20	7	41	1
4	1	21	6	45	4
6	4	22	4	47	1
7	3	23	2	49	1
8	2	24	1	50	3
9	2	25	4	52	1
10	3	26	2	56	1
11	4	28	3	60	3
12	9	30	5	62	1
13	2	31	1	65	1
14	6	33	1	70	1
15	5	35	3	75	3
16	8	36	1	76	1
17	1	37	1	150	2
18	2	38	2	160	1
19	1	40	1	175	1

TABLE II

Number of Pupils Per Recitation Section

Number of Pupils	Number of Schools	Number of Pupils	Number of Schools	Number of Pupils	Number of Schools
3	1	13	3	23	3
4	2	14	8	24	3
6	4	15	5	25	12
7	4	16	12	26	2
8	3	17	4	28	1
9	4	18	8	30	6
10	4	19	4	33	1
11	4	20	15	35	2
12	5	21	6	36	1
		22	3	104	1

Answers to questions 1, 2, 3, 4, 5, 10, 11, 12, 13, 14, 16, 17, 19, 20, 21, 22, 23, 24 and 25 received from 150 of the 172 high schools from which replies came are answered graphically, wholly or in part, on the accompanying chart. The remaining 22 schools do not teach chemistry.

In reply to the last question under No. 4 data shown in Table I. were obtained.

TABLE III

Number of Pupils Per Laboratory Section

Number of Pupils	Number of Schools	Number of Pupils	Number of Schools	Number of Pupils	Number of Schools
2	1	12	9	21	5
3	1	13	3	22	4
4	2	14	6	23	2
6	5	15	6	24	3
7	6	16	10	25	10
8	8	17	4	26	2
9	5	18	7	30	12
10	7	19	2	33	1
11	4	20	11	35	1

Answers to 5 (*d*) are given in Tables II. and III.

Answering question 6 the following information was given regarding text-books in use.

Avery—2
Blanchard & Wade—11
Bradbury—1
Brownlee and others—52
Cook—1
Fuller—19
Green & Keller—1
Godfrey—1
Gunnison—1
Hessler & Smith—1
Hitchcock—1
Morgan & Lyman—4
McPherson & Henderson—31
Newell—22
Remsen—2
Smith—1
Weed—2
Williams—1

Answering question 7 the following information was given concerning laboratory manuals.

A. H. S. Manual—1
Brownlee—31
Dennis & Clark—4
Cook—1
Fuller—9
Godfrey—2
Knott—3
Morgan & Lyman—5
McFarland—1
McPherson & Henderson—24
Newell—18
Remsen—1
Smith—1
Weed—2
White—1
Whitman—6
Williams—5

From answers to question 8 it was ascertained that the following elements, of those listed, are omitted from courses given in the number of schools indicated.

Antimony	17	Gold	16
Arsenic	13	Iodine	3
Barium	10	Manganese	7
Bismuth	22	Nickel	12
Boron	18	Phosphorus	2
Bromine	4	Radium	49
Cadmium	32	Silicon	11
Chromium	16	Strontium	27
Cobalt	13	Tin	5
Fluorine	10		

In answer to question 9 it was found that the following theories, laws and principles are omitted by the number of schools indicated.

Law of constant proportions—3, combining weights—2, Boyle's law—2, kinetic molecular hypothesis—26, Avogadro's law—3, Gay-Lussac's law—5, catalytic agent—3, allotropism—16, osmotic pressure—21, freezing and boiling point effects—7, gram molecular volume law—21, Du-Long and Petit's law—51, periodic arrangement of elements—15, Moseley numbers—99, electron theory—19, structure of atom—27, ionization—2, Faraday's law—25, equilibrium—8, thermal equation—45, colloids—45.

Question 15 is answered in Tables IV., *A*, *B* and *C*.

TABLE IV

(*a*) *Number of Lectures per Week per Instructor*

Number of Lectures	Number of Schools	Number of Lectures	Number of Schools	Number of Lectures	Number of Schools
1	25	4	3	6	2
2	9	5	2	7	2
3	7			8	2

(*b*) *Number of Recitations per Week per Instructor*

Number of Recitations	Number of Schools	Number of Recitations	Number of Schools	Number of Recitations	Number of Schools
1	17	7	2	16	1
2	24	8	6	18	1
3	24	9	2	20	1
4	16	12	6	21	1
5	6	14	3	25	1
6	3	15	3	26	1

With reference to question 18 it is gratifying to note that most of the science teachers in high schools are graduates of reputable colleges and universities. The writer has a list showing the number from each institution. This list is available for any one who may be interested. It would seem unnecessary to include the institutions here, because of the large amount of space required for the purpose. Seventy-four institutions are included in the list already compiled.

(*c*) *Number of Hours of Laboratory per Week per Instructor*

Number of Lab. Hours	Number of Schools	Number of Lab. Hours	Number of Schools	Number of Lab. Hours	Number of Schools
1	11	6	6	12	5
2	22	7	1	14	1
3	21	8	7	15	3
4	11	10	6	16	3
5	7			17	1

It is evident from the variety of answers already received that standardization is necessary. For this purpose the state should have a permanent committee, as long as the United States Commissioner of Education is not empowered to establish standards and enforce them. The latter procedure is naturally more desirable, as it would enable all colleges and universities to plan their courses as continuation courses instead of repeating much of the material which students in some high schools have already covered.

The writer wishes to acknowledge valuable assistance rendered by Miss Marcella Schwer.

Alexander Silverman
School of Chemistry,
University of Pittsburgh

TWENTY-FIVE IMPORTANT TOPICS IN THE HISTORY OF SECONDARY MATHEMATICS

The rapid increase in the number of the historical notes in our recent text-books on elementary and secondary mathematics raises the question, What should be the dominating motive in the selection of such notes? The history of mathematics is so enormous that it is clearly impossible to present a considerable part of it in such notes, but it would be possible to select for them some of the central elements of this history, which might become

nucleuses for the student's further development along this line.

To emphasize the fact that some of the present historical notes are useless from this standpoint we may mention that many of our elementary geometries state that according to tradition Pythagoras was so jubilant over his discovery of the Pythagorean theorem that he sacrificed 100 oxen to the gods on the occasion. It is difficult to see why authors of text-books waste space on such a statement. It is probably not true that such a sacrifice was made by Pythagoras, and if it were true, it could only lessen our respect for him. Just imagine meeting now a man in the act of sacrificing 100 oxen because he had made a mathematical discovery. Would you not conclude that he ought to be in an asylum for the insane?

By the time the average student reaches college he may easily have read twenty-five historical notes in his various mathematical text-books. It is therefore of interest to list twenty-five topics which have been epoch making in the development of pure mathematics and are nucleuses of an extensive history. It can scarcely be expected that all would agree entirely on what twenty-five points should be regarded as most important in the history of secondary mathematics but one may perhaps assume general agreement as regards the fact that each of the subjects of the following list is worthy of consideration in connection with this question. The order of these subjects is supposed to be chronological with respect to the beginnings of their history. (1) Numeration and notation; (2) Value of π; (3) Irrational quantities and irrational numbers; (4) Science of elementary geometry; (5) Science of elementary algebra; (6) Translations of treatises into a different language; (7) Science of trigonometry, or arithmetical geometry; (8) Algebraic solution of the general cubic and of the general biquadratic equation; (9) Use of logarithms for numerical calculations; (10) Science of analytic geometry, or algebraic geometry; (11) Science of differential and integral calculus; (12) Scientific societies supporting publications; (13) Special mathematical periodicals; (14) Ecole polytechnique; (15) Science of arithmetic, or the theory of numbers; (16) Reality of complex numbers; (17) founding of descriptive and projective geometry; (18) Theory of functions; (19) Non-euclidean geometry; (20) Theory of groups; (21) Johns Hopkins University; (22) Theory of aggregates; (23) International mathematical congresses; (24) Large modern mathematical encyclopedias; (25) International commission on the teaching of mathematics.

The above list of twenty-five important topics in the history of secondary mathematics does not include any of the subjects of applied mathematics, which have furnished strong motives for the development of pure mathematics. From the earliest times astronomy and surveying have furnished such motives especially for the development of spherical and plane trigonometry respectively. Among the subjects which furnished strong motives for some of the later developments in pure mathematics we may mention celestial mechanics, hydromechanics, and the theory of heat.

Some may be surprised to find in the above list of important topics the names of two institutions, but a little reflection will tend to make it clear that these institutions have been the centers of unusually strong mathematical influences. The early courses offered at these institutions are of great historical interest. It is true that the influence of the latter might be regarded to have been national rather than international, but the national activity which it fostered has been sufficiently extensive to merit general recognition.

It is, however, not our purpose to justify the particular selection of topics noted above. If this list will tend to direct the attention of teachers and authors to the really serious and fundamental questions of mathematical history, the purpose of its compilation will be fulfilled. Just as the material of the body of a text-book is selected with a view to furnishing matter of permanent usefulness rather than to arouse ephemeral interest, so it seems that the material for the historical notes

should be selected primarily with a view to furnishing enjoyment by growth of knowledge about the history of our subject.

The topics of this list may also be suitable subjects for consideration at meetings of mathematical clubs. In fact, it is especially important that the subjects selected for such metings should be fertile, since those who take active part in them include to a large extent the mathematicians of the future, and these mathematicians can not afford to be as ignorant of the history of their subject as are those of the passing generation.

G. A. Miller

University of Illinois

SCIENTIFIC EVENTS

THE CLEVELAND MEETING OF THE AMERICAN CHEMICAL SOCIETY

The annual September meeting of the American Chemical Society will be held at the Hotel Statler, Cleveland, Ohio, September 10 to 13, 1918, inclusive. There is every prospect of a large and successful meeting. The chemists of the country are showing a very decided desire to get together in these war times for conference at a time when it is so difficult to keep in touch with the progress of chemistry through our literature. A meeting of this kind offers special inducements to members of our society to keep themselves abreast of the time. Wonderful chemical advancement has taken place in America during the last year. Many chemists, both from the government service and from the industries, will be present.

Registration will begin at 3 p.m., September 9, at the Statler Hotel. Information regarding other hotels may be obtained from the chairman of the committee on hotels.

The general preliminary program is as follows:

Monday, September 9

4 p.m.—Council meeting at the University Club, Euclid Avenue and East 38th Street. Dinner there for the Council as guests of the Cleveland Section.

Tuesday, September 10

10 a.m.—General meeting. "The American Chemist's Place in Warfare," by Charles L. Parsons, Chairman of the Committee on War Service for Chemists.

Other general papers to be announced.

2 p.m.—General Symposium on the Chemistry of Dyestuffs. R. Norris Shreve, Chairman. Numerous interesting papers and addresses are being prepared. These will take up the whole of the afternoon of Tuesday and may continue on Wednesday morning in the Industrial Division.

Evening.—Banquet, Hotel Statler, followed by a smoker at the same place.

Wednesday, September 11

Morning.—Divisional meetings—Hotel Statler.

Afternoon.—Choice of excursions.

(*a*) Sanitary trip, including sewage disposal experiments, water filtration, garbage disposal.

(*b*) Steel industries, blast furnaces, by-product coke, steel—bessemer and open hearth.

(*c*) Industrial tour of Cleveland, including manufacturing centers.

(*d*) Trip to Oberlin.

Evening.—President's address, followed by informal reception.

Thursday, September 12

Divisional meetings all day.

Late Afternoon.—Outing to one of the country clubs, followed by reception at the Cleveland Museum of Art.

Friday, September 13

Choice of excursions.

(*a*) By special cars to Akron—Goodrich Rubber Co. (limited to 200), Knight Chemical Stoneware plant, and possibly pottery works.

(*b*) Auto trip to Wadsworth, near Akron—Ohio Match Co., Ohio Salt Works, and Ohio Brass Co. (limited to 50).

The usual meetings, including the annual election of officers, will be held by all the Divisions, and by the Rubber Chemistry Section, with the following special program:

The Division of Biological Chemistry is planning a symposium on plant chemistry.

The Division of Industrial Chemists and Chemical Engineers, besides continuing the symposium on the chemistry of dyestuffs, is planning a symposium on potash and a continuation of the very successful symposium on metallurgical subjects started at the Boston meeting.

The committee headed by Miss Josephine Grasselli will arrange a program for the pleasure of the visiting ladies. Details will be found in the final program.

All titles for papers should be in the secretary's hands on or before August 24 or in the hands of the secretaries of divisions on or before August 23, with the exception that titles of papers should reach the secretary of the Division of Industrial Chemists and Chemical Engineers on or before August 18. The Division of Industrial Chemists and Chemical Engineers have voted that the titles of all papers shall be sent to the secretary of the division, which title should be accompanied by an abstract; that any tile sent without an abstract shall not be printed in the program, and that the time limit for the presentation shall be five minutes, unless special arrangements are made with the secretary of the division. *By vote of the council no papers may be presented at the meeting titles for which are not printed on the final program.* "By Title" should be placed on the announcement of any paper where the author is to be absent, so that members may understand in advance that the paper will not be read.

The following are the addresses of the divisional secretaries:

Agricultural and Food Chemistry: Fred F. Flanders, 88 Corey Road, Brookline, Mass.

Biological Chemistry: I. K. Phelps, Bureau of Chemistry, Washington, D. C.

Fertilizer Chemistry: F. B. Carpenter, Virginia-Carolina Chemical Co., Richmond, Va.

Industrial Chemists and Chemical Engineers: S. H. Salisbury, Jr., Northampton, Pa.

Organic Chemistry: H. L. Fisher, Columbia University, New York City.

Pharmaceutical Chemistry: George D. Beal, Chemistry Building, University of Illinois, Urbana, Ill.

Physical and Inorganic Chemistry: W. E. Henderson, Ohio State University, Columbus, Ohio.

Water, Sewage and Sanitation: W. W. Skinner, Bureau of Chemistry, Washington, D. C.

Rubber Section: J. B. Tuttle, Secretary, Firestone Tire & Rubber Co., Akron, Ohio.

In order that the meeting may receive due and correct notice in the public press, every member presenting a paper is requested to send an abstract to Professor Allen Rogers, Pratt Institute, Brooklyn, N. Y., chairman of the society's press and publicity committee. The amount of publicity given to the meeting and to the individual papers will entirely depend upon the degree to which members cooperate in observing this request. A copy of the abstract should be retained by the member and handed to the secretary of the special division before which the paper is to be presented in Cleveland. Short abstracts will be printed in SCIENCE. The final program will be sent to all members signifying their intention of attending the meeting, to the secretaries of sections, to the council, and to all members making special request therefor by postal card or attached slip to the secretary's office.

CHARLES L. PARSONS,
Secretary

THE JAPANESE BEETLE IN NEW JERSEY

A PUBLIC hearing on the proposed quarantine of a portion of New Jersey on account of the Japanese beetle, a serious pest of certain vegetables and fruit, was held by the United States Department of Agriculture in Washington, D. C., on August 20. As a result of infestation of the Japanese beetle in parts of Burlington county, New Jersey, the proposed quarantine is intended to prohibit the shipment from this territory of green sugar corn, ripe tomatoes and ripe peaches which might cause this pest to spread. A campaign of eradication authorized by Congress is now in progress, and the proposed quarantine is deemed necessary to support the measures that are being taken for the suppression of this dangerous pest.

The insect was introduced in the vicinity of Riverton, N. J., probably during the last five or six years, and presumably from Japan, in soil around the roots of iris. The beetle has thoroughly established itself, and from some 600 acres infested when the insect was first discovered it has spread and at present occurs over 7,000 to 10,000 acres, with one or two outlying points of infestation, involving approximately 25,000 acres. It is reported to be one of the most injurious insects of Japan, and its behavior in this country indicates exceptional possibilities for damage.

The insect is a general feeder, attacking the grape, peach, plum, apple and cherry, as well as many ornamental plants. It has been found injuring the sweet potato and other truck crops, especially sweet corn. The beetles penetrate the tips of the ears of sweet corn much like the common corn ear-worm and could thus be widely distributed with the shipment of the corn to the various markets. The insect feeds freely on a variety of weeds, especially smartweeds. As far as known it does not occur in other parts of the United States than in the area indicated.

THE REHABILITATION OF WOUNDED SOLDIERS[1]

Detailed reports compiled at five general hospitals indicate the progress being made by the Reconstruction Division of the Medical Department of the Army. Of the 537 cases sent to these hospitals from overseas and base hospitals in this country, 151 are now able to return to full duty and 212 are able to return to partial duty. Only 39 of these soldiers will be unable to follow their old occupations. A total of 122 will be able to return to their old employment and do efficient work, despite their injuries.

From the time these men landed in the United States an effort has been made to keep their minds and hands occupied. Curative education has been practised with satisfactory results. The men have shown interest in the "ward occupations," which consist of wood carving, knitting, weaving, block printing, bead-work, knotted work, embroidery, educational work and typewriting. Where facilities have been provided to give the men academic studies a genuine interest has been shown to improve their mental condition so as better to prepare them to make progress in civil occupations.

After the men reached the point where they could leave the wards they were instructed in shops and schools. Quartermaster repair shops are located near some of the hospitals and these are used to give instruction to the men in mechanical occupations. At the present time 132 soldiers are taking courses in auto mechanics and repair work.

Shorthand and typewriting have attracted the attention of 151. Other popular trades and the number of patients receiving instruction in them are as follows:

Drafting, 53; business, 49; agriculture, gardening and other work of similar nature, 235; telegraphy, 31; carpentry and bench work, 32; telephone, 47; furniture repairing, 18; painting, 11; electrical, 5.

A few men are taking courses in each of the following subjects:

Blacksmith, concrete working, bricklaying, plumbing, commercial law, printing, shoe repairing, woodworking, sign painting, cabinetwork, cartooning, drawing, ring making, bookbinding and willow work.

The disabilities of these men and the number suffering from each is given below. In some cases men are being treated for more than one ailment, hence the difference between the number of patients, 537, and the number of disabilities, 1,034.

Medical diseases: Cardio-vascular, 172; pulmonary tuberculosis, 83; functional neurosis (shell shock, etc.), 31; insanity, 11; nephritis, 25; gastro-intestinal, 17; gassed, 7; other general medical, 166; convalescent, 96; lung conditions (empyema), 23.

Surgical conditions: Orthopedic, 155; amputation, 42; eye, ear, nose, throat, 6; wound or injury, nervous system, 14; severe injury, face and jaw, 1; venereal diseases or sequelæ, 5; surgical condition genito-urinary system—

[1] Publication of statement from the office of the Surgeon-General, authorized by the War Department.

venereal, 9; non-venereal, 1; other surgical conditions, 59; convalescent, 111.

Total, 1,034.

The five hospitals reporting are: The Walter Reed, of Washington, D. C.; general No. 2, at Fort McHenry, Md.; general No. 6, at Fort McPherson, Ga.; general No. 9, at Lakewood, N. J.; and general No. 17, at Markleton, Pa.

THE VOLUNTEER MEDICAL SERVICE CORPS

UNDER a plan announced on August 13 by Dr. Franklin Martin, chairman of the General Medical Board, Council of National Defense, the medical men and women of the country are to be mobilized by the Volunteer Medical Service Corps. This organization is authorized by the Council of National Defense and approved by President Wilson.

The plan provides for the enrollment of every qualified physician, man or woman, without reference to age or physical disability, not now in the service of the government.

In a letter to Dr. Martin, approving the reorganization of the corps, President Wilson says:

In cooperation with the General Medical Board of the Council of National Defense, the strong governing board of the reorganized corps will be able to be of increasing service. Through it the finely trained medical profession of the United States is not only made ready for service in connection with the activities already mentioned, but the important work of the Provost-Marshal General's office and the Red Cross will be aided and the problems of the health and of the civilian communities of the United States assured consideration.

I am very happy to give my approval to the plans which you have submitted, both because of the usefulness of the Volunteer Medical Corps and also because it gives me an opportunity to express to you and through you to the medical profession my deep appreciation of the splendid service which the whole profession has rendered to the nation with great enthusiasm from the beginning of the present emergency.

The health of the army and the navy, the health of the country at large, is due to the cooperation which the public authorities have had from the medical profession; the spirit of sacrifice and service has been everywhere present and the record of the mobilization of the many forces of this great republic will contain no case of readier response or better service than that which the physicians have rendered.

Members of the corps will be divided into three classes:

Fit to fight, men under forty.

Reserves, under fifty-five.

Home forces, over fifty-five.

Reserves will consist of those who may be called upon for the army, navy, public health service and civilian service when necessity requires. The home forces are those who are able to do civilian service only.

SCIENTIFIC NOTES AND NEWS

THE American Central Medical Department Laboratory has been inaugurated in a French university town. Lieutenant Colonel George B. Foster, Jr., is the director. Among the scientific men who have been working at the laboratory are Major William J. Esler, professor of bacteriology at Cornell University; Major Richard P. Strong, professor of tropical diseases at the Harvard Medical School; Major Hans Zinsser, professor of bacteriology at Columbia University; Major W. B. Canon, professor of physiology at the Harvard Medical School.

DR. OSCAR H. SELLINGS, Columbus, Ohio, who was recently placed in charge of the work of the American Red Cross for the children of Marseilles, France, has been made head of the temporary commission sent by the American Red Cross to Italy.

L. W. CHASE, professor of agricultural engineering at the University of Nebraska, has been appointed major in the Ordnance Corps, U. S. Army.

ASSISTANT PROFESSOR HARVEY B. LEMON, of the department of physics, University of Chicago, has been commissioned captain in the Ordnance Department of the Army and assigned to duty as head of the instrument division of the proof department of the Aberdeen Proving Ground, Aberdeen, Md.

PROFESSOR MAX M. ELLIS, of the department of biology of the University of Colorado, has

been given leave to accept a commission as first lieutenant in the Sanitary Corps. He is stationed at Mineola, L. I., for work with the Medical Research Board of the Air Service Division.

Dr. C. A. Brautlecht, professor of chemistry in the Florida State College for Women, has been called into the Sanitary Corps as first lieutenant. He is stationed at the Rockefeller Institute for Medical Research at New York.

Dr. James F. Kemp, formerly professor of geology in Columbia University, has left Tulsa, Oklahoma, to resume permanent residence in New York.

Dr. M. Lebredo, a leading hygienist and bacteriologist of Cuba and a member of the editorial staff of the *Revista de Medicina y Cirugia* of Havana, has been appointed a member of the Rockefeller Institute and is leaving on a scientific mission for Ecquador on behalf of the institute.

G. I. Christie, superintendent of agricultural extension of Purdue University, has been granted leave of absence to become assistant to the secretary of agriculture, in charge of farm-labor problems. T. A. Coleman, state leader of county agents, will serve as extension director during his absence.

Professor G. A. Miller, of the University of Illinois, has accepted the chairmanship of a committee which is to make a survey of the mathematical instruction given under the auspices of the Y. M. C. A. at the various naval stations.

Dr. Lucius P. Brown, who, following an investigation of the health department by the Hylan administration, was tried on charges of neglect of duty and acquitted, has been unanimously reinstated as director of the bureau of foods and drugs of the New York Health Department.

William Earl Hidden, known for his work in mineralogy, died at Ocean Grove, N. J., on June 12, 1918, at the age of sixty-five years.

The death is announced, on July 14, of Dr. R. O. Cunningham, emeritus professor of natural history and geology, Queen's College, Belfast, at the age of seventy-six years.

Dr. Alfred Senier, since 1891 professor of chemistry in Queen's College and University College, Galway, Ireland, died on June 29, aged sixty-five years. His parents, about two years after his birth, emigrated to Wisconsin, where he received his early education; in due course he attended the universities of Wisconsin and Michigan. Professor Senier's researches in organic chemistry were devoted mainly to the cyanuric acids, to the acridines and to phototropic and thermotropic phenomena.

Professor J. Bishop Tingle, of McMaster University, Toronto, died at Ottawa, on August 6, after an illness of some weeks. Dr. Tingle was born at Sheffield, England, in 1866, and received his early training at the Royal Grammar School of Sheffield and at Owens College, Manchester. He took his degree, after working with Claisen at Munich, in 1889. He came to America in 1896 and after some years at Lewis Institute, Chicago, Illinois College, Jacksonville and Johns Hopkins University was appointed to the chair of chemistry at McMaster University. He was elected fellow of the Royal Society of Canada in May, 1918. He was the author of a considerable number of scientific papers. Several of his students are already rising to positions of prominence as chemists. He was a pioneer, against much discouragement, in training young women for laboratory positions under war conditions. He married Sarah Ellen Capps, of Jacksonville, Illinois, in 1906. She survives him with a daughter and a son, also a younger brother and sister. Dr. Tingle was a valued friend to those who knew him intimately and he always took a close personal interest in the future of his students.

For the care and conditioning of fliers in the Air Service the United States Government is now appointing a corps of doctors and trainers large enough to equip each training field and camp for fliers, both here in the United States and in France, with a proper organization. The doctors will be known as flight surgeons and the trainers as physical directors. The medical branch of the Air Service is not alone confined to the selection of the flier but to his care and condition after

he has been admitted to the service. It has become apparent that the flier is unlike other soldiers. In the Air Service he has become an intricate, highy sensitized piece of mechanism with troubles all his own. To keep his complex organism physically fit a special master mechanic had to be provided solely for him. The flight surgeon, therefore, has been given freedom of independent initiative in all questions of fitness of the fliers. Subject to the approval of the commanding officer, he is expected to institute such measures as periods of rest, recreations, and temporary excuse from duty as may seem advisable. He takes sick calls of aviators, he visits such cases as may be in the hospital and consults with the attending surgeon regarding them. He makes the examination of candidates for aviation and lives in close touch with fliers. The physical directors are assistants to the flight surgeons and their duty is to supervise such recreation and physical training of the fliers as is considered necessary.

A THREE months' course at New York University and Bellevue Medical College will begin on September 4 for laboratory assistants, trained in bacteriological work. They are needed for immediate service for camp and hospital work. The course is in response to a request of the surgeon general's office of the War Department. There will be daily sessions from 9 to 5, except Saturdays. Efforts to secure scholarships covering the cost of tuition for expressly qualified women will be made. Futher information can be secured from Dr. William H. Park, at the Department of Health laboratory, foot of East Sixteenth Street.

NEARLY 50,000 physicians will be required for war service eventually, according to the Army and navy authorities, and in order to prevent the disorganizing of their teaching staffs of the medical schools, it is proposed to commission all teachers and assign them to their present duties. Of the 143,000 doctors in the United States it is estimated that between 80,000 and 95,000 are in active practise and that 23,000 are in the Army or Navy.

THE War Department has approved the request of the director of Chemical Warfare Service to furlough back to approved institutions a limited number of teachers of chemistry. This furlough will be administered by the committee on education and special training, old Land Office Building, Washington, D. C., upon recommendation of the officer in charge of university relations, Chemical Warfare Service. Approved institutions which have already lost many of their instructors through draft or enlistment may now make application for the return of such men, provided that the return is agreeable to the men themselves. In the event of failure to secure the men asked for, the relations section may be able to provide for the assignment of other men whose qualifications would seem to fit them to carry on the work of instruction. Application for furlough of enlisted men should be made to Chemical Warfare Service, University Relations Section, Seventh and B streets, Washington, D. C.

A BILL "to prohibit the importation of nursery stock into the United States in order to prevent the introduction of insect pests and plant diseases" (Senate Bill No. 3344) has been introduced by Senator Weeks of Massachusetts. The bill is of considerable interest to entomologists, plant pathologists, horticulturists, and all who have observed the repeated introduction of insects and plant diseases on imported nursery stock, particularly during the past fifteen years. The bill provides that it shall be unlawful for any person to import or offer for entry into the United States any nursery stock, with the exception of field, vegetable and flower seeds, bedding plants and other herbaceous plants, bulbs and roots. It is provided, however, that the Secretary of Agriculture may import, grow, and propagate nursery stock for experimental and scientific purposes, and after holding this stock in quarantine for a length of time sufficient to establish its freedom from insect pests and plant diseases, he may distribute it under such regulations as may be necessary.

THE United States Coast and Geodetic Survey has issued a map of the north Atlantic Ocean, including the eastern part of North America and the greater part of Europe. The western limits of the map are Duluth to New Orleans; the eastern limits Bagdad to Cairo; extending from Greenland in the north to the West Indies in the south. The scale is 1:10,000,000. The map brings the two continents vis-a-vis in an approximately true relation and scale in an extremely clear manner, and will serve as an excellent base for various purposes. It is constructed on a system of projection which is peculiarly adapted to this wide expense, and is known as the Lambert Conformal Conic Projection with two standard parallels. The scale on the two standard parallels (36 middle parallel (41 degrees north) it is but 1½ per cent. too small, and beyond the standard degrees and 54 degrees north) is true; on the parallels the scale becomes increasingly large. The map covers a range of longitude of 170 degrees on the middle parallel—a range which on many other projections of this area would have distinctions and scale errors so great as to render their use inadmissible. This map can be obtained by writing to the department of the United States Coast and Geodetic Survey. The map is 24 by 46 inches, No. 3,070 and sells for 50 cents.

THE *Journal* of the American Medical Association states that for seventeen years Dr. M. Uribe Troncoso edited the *Anales de Oftalmologia* in Mexico, but with his recent removal to New York, this journal was merged with others to form the *American Journal of Ophthalmology*. The Mexican Ophthalmologic Society, of which he was long president, has now decided to publish its own annals, and the *Anales de la Sociedad Oftalmologica Mexicana* has already made its appearance. Dr. D. M. Velez is director of the *Anales* and perpetual secretary of the society. Summaries of the two leading articles are given in both English and French, and duplicates are published on an insert for convenience of reviewers. The officers of the society for 1918 include Dr. F. Lopez, president; Dr. A. Chacon, vice-president, and Dr. E. F. Montaño, perpetual treasurer.

THE Committees on Agriculture and on Administration and Commissions of the Massachusetts legislature have reported a bill to abolish the present Board of Agriculture and to substitute a board consisting of a commissioner of agriculture at $5,000 annually and fourteen unpaid advisory associates, one from each county. The present board consists of forty odd members. The secretary is executive officer. The bill makes no provision for the proposed consolidation of the Board of Agriculture with the Bureau of Animal Industry, State Forestry Department and Fish and Game Commission.

ON April 9 an allotment of $25,000 was made by the President from the fund for the national security and defense for the purpose of enabling the Bureau of Fisheries to install a plant on the Pribilof Islands for the utilization of the by-products in connection with the taking of fur seals on these islands. This is regarded as vitally important at the present time in order to increase the production of oil and fertilizer. It is planned to make use of the carcasses which will result from the increased killings of fur seals this year. It is believed that the plant will more than pay for itself in the first season of its operation. Every effort is being made to obtain delivery of the plant in time to utilize the maximum quantity of seal carcasses during the current year. On April 27 the steamer *Roosevelt* left Seattle with a full cargo of general supplies for the Pribilof Islands. The cargo consisted of building materials, foodstuffs, and miscellaneous items. It was planned to return with utmost dispatch, bringing back such sealskins as were ready for shipment, in order that another trip may be made as soon as possible to transport material for the by-products plant.

THE permanent secretary of the Paris Academy of Medicine has been authorized to accept, in the name of the academy, a legacy of 25,000 francs made by the late Dr. Magnan. The revenue from this sum will be used to establish a triennial prize to be awarded to the author of the best work on mental medicine.

After due consideration of a number of proposals for the alteration of the British system of weights and measures, such as the compulsory adoption of the metric system and the decimalization of the existing weights and measures, the British trade committee has decided against any compulsory changes at the present juncture, but recommends a continuation of the efforts toward simplification in the teaching of weights and measures and the use of decimal subdivision of basic weights, such as the cental of 100 pounds instead of the hundredweight (112 pounds) and the short ton of 2,000 pounds. The committee recognizes the value of the proposal for the decimalization of the sovereign, which would be divided into 1,000 mils, the mil being worth 4 per cent. less than the farthing. It believes, however, that considering "the magnitude of the disturbance which the alteration in the value of the penny would cause in the lives of the great body of wage earners, retail shopkeepers and their customers . . . the introduction of such a change would be inexpedient at a time when the social, industrial and financial organization of the country will be faced with numerous and exceptional difficulties."

The second reading of the British Coinage (Decimal System) Bill was moved by Lord Southwark in the House of Lords on June 4. Lord Leverhulme opposed the motion, though he was not against the principle of decimal coinage. He objected to making the sovereign the unit and dividing it into one thousand parts, and he thought that a British decimal system of coinage should be based upon the halfpenny. After discussion, the debate was adjourned on the understanding that the government will institute an inquiry into the whole question of decimal coinage, including the proposals contained in Lord Southwark's bill.

The Bureau of Mines announces the perfection of a type of electric melting furnace that may be revolutionary in the making of brass. Patents on this furnace, known as the rocking electric furnace, have been taken out by the bureau and have been assigned to Secretary Lane as trustee. Free licenses to operate these furnaces under the patents, it is understood, can be obtained by making application through Van. H. Manning, director of the Bureau of Mines. The new furnace, which it is claimed will reduce the important losses in brass melting, is the result of five years' experimentation by H. W. Gillett, chemist of the Bureau of Mines, in cooperation with the laboratory of Cornell University, the American Institute of Metals, and a number of manufacturers of brass.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of the late Lord Rhondda the governing body of Gonville and Caius College, Cambridge, will receive out of the residue of his estate the sum of £20,000, to be applied at its discretion for the benefit of the college, but preferably in the establishment and maintenance of six to ten scholarships tenable at the college for mathematics, natural science, or moral science (including economics), preference being given, *ceteris paribus,* in the awarding of such scholarships to residents or sons of residents in Wales or Monmouthshire.

A. H. Benton, assistant professor of farm management, at the University of Minnesota, has accepted a position as professor and chief of the division of farm management and rural economics at the Manitoba Agricultural College.

A. B. Coble, associate professor of mathematics in Johns Hopkins University, has accepted a professorship of mathematics in the University of Illinois to begin work in September.

Dr. Aven Nelson has been appointed president of the University of Wyoming.

DISCUSSION AND CORRESPONDENCE

PSEUDO-PSYCHOLOGY

To the Editor of Science: Through no fault of their own, not a few instructors of elementary psychology to my knowledge spend many an arduous hour trying to indicate to undiscriminating minds both what psychology

is not and what is not psychology. Press reporters, magazine writers, novelists, dramatists, preachers, popular lecturers, and advertising experts, are responsible for much psychological heresy that is so deeply rooted in the lay mind. But equally pernicious is the influence of teachers, yes, even academic colleagues in other disciplines, who, though their tutelage in psychology dates back to a previous generation, flaunt their opinions on the subject as if antiquity of the vintage were a guarantee of acceptability of the doctrine. Coupled with these agencies for the propagation of malefic and subversive statements is the human, almost inhuman, tendency to conjure with words and phrases that are suggestive of possibility but, among those so using them, not redolent with meaning or precise in definition. Thus have "psychology" and "psychological" suffered immensely. For what member of an English-speaking community can fail to be impressed, if not inspired, by the sound of the expression, "the psychological moment"! What greater distinction can be accorded an insignificant alienist in court than to whisper with bated breadth or to state in bold type that he is a famous "psychologist"! It has been said that officers in camp frequently explain the inexplicable in similar terms. Indeed, a current committee of the American Psychological Association has found it necessary to indicate restricted usages of the term "psychological" even among professional psychologists. But to my mind the most insidious of all baleful influences are to be found in connection with such commercialized undertakings as impose upon the ignorance of the general public to the extent of taking advantage of its credulity. Whether the intention of doing this is present or absent, is difficult of proof and, moreover, not to the point: the effect is the same.

The week's mail brought to my notice an attractively printed pamphlet describing the aims and scope of an incorporated "National Psychological Institute." Hence the occasion for these remarks. The individual whose name appears on the title page is the medical adviser and a trustee of the institute. His credentials indicate that he is a member of several medical societies, fellow of the American Medical Association, member of the American Association for the Advancement of Science, and of the National Geographic Society. No affiliation with any psychological association is mentioned. The institute "was organized in the firm realization that the Science of Life and an intelligent appreciation of the relationship between the visible and the invisible world, constitutes not only the highest form of religion but also falls within the domain of scientific endeavor" and for the purpose of carrying on "experimental research in normal and abnormal psychology and demonology . . . , to develop and instruct psychic-sensitives, as intermediaries in above stated experimental research, and grant certificates to same when proficient," etc. "Despairing mortals, on the brink of a suicide's grave, are especially urged to communicate (strictly confidentially) with the institute for advice regarding so serious a step." We are told that "research in abnormal psychology has unmistakably demonstrated that ignorant or mischievous discarnated human entities do frequently play a serious rôle in all manner of functional mental aberrations and insanity, the ravages of which, according to eminent authorities, are threatening the very social fabric." More specifically the symptomatology of shell shock "suggests obsession or possession by spirits of dead soldiers . . . as the exciting cause."

These quotations and other uncited but similar statements speak for themselves. It is not my purpose to decry earnest endeavor to gain knowledge in fields in which its pursuit has not so far been very fruitful. For many years, as my students can no doubt abundantly testify, my attitude toward psychic research has been respectfully sympathetic. In my reviews of publications on the subject, moreover, I have been no more critical than are the foremost investigators in this field. Nor do I intend to charge this institution with an attempt to defraud the public for financial gain. Representations in the pamphlet indicate that the organization is benevolent and humanitarian in character and not established for profit.

What that means is, perhaps, not altogether clear because "dependable automatists" are to be trained and awarded certificates, abnormal cases are to be treated, and negotiations with other institutions are encouraged, but surely not without fee. No, my chief criticism is simply: why do all this under the name of *psychology?* There is hardly an academic institution that would designate this subject as anything but "psychic research"; and certainly, if I judge aright, no scientific body of psychologists would endorse the selection of so ambitious a title for organizations at work in the field described in the pamphlet. The use of such a name involves bad taste and delusion, if it does not also bespeak audacity and professional discourtesy. Especially at this time of national service in an emergency ought scientific bodies to be particularly sensitive lest those in authority who are susceptible to misinformation proceed to belittle and to caricature the achievements already won. This is peculiarly true of so youthful a scientific discipline as psychology.

Christian A. Ruckmich
University of Illinois

THE POSITION AND PROSPECTS OF BOTANY

To the Editor of Science: There are times when it is perhaps to be expected that the naturalist should feel, more insistently than other scientific men, the impulse to justify the pursuits with which he has chosen to occupy his time. The recent address by Dr. Gager, concerning the position and prospects of botany, printed not long ago in Science, prominently conveys an attempt of this kind. Like most of the pleas advanced by investigators in defence of their performances, this address develops the traditional theme of economic benefit accruing to society at large, and more specifically to certain groups of business interests, as the result of research activities.

It is strange that the peculiar futility of this type of apologetic seems not to be more generally appreciated. That the results of scientific inquiry contribute to the well-being of humanity is a tiresome truism, which has no bearing upon the support of research by business interests. Perhaps in despair at the lack of other common ground upon which to engage in discussion with nonscientific acquaintances, perhaps from the honest conviction that economic good is the main consideration in this matter, investigators have at any rate been far too willing to point to useful inventions, commercial practises and hygienic improvements, as the crowning fruits of the spirit of discovery. To this habit may in large degree be traced the origin and perpetuation of that conception, commonly enjoyed by cultivated people of nonscientific interests, that science is a vaguely delimited mélange of engineering, sanitation, surgery and what not else.

To encourage the demand, upon specific economic grounds, that research in biology should receive the financial support of commercial organizations is futile and dangerous: it is also a tactical error of the first magnitude. It is futile because the appeal fails, and in the nature of things must fail, to impress the people for whom it has been designed; because it omits to reckon with the fact that "usefulness," in the ordinary understanding of that attribute, is an accidental by-product of research. It is dangerous because, as Dr. Sumner has clearly expressed it in another connection,[1] "the investigator who derives his support from the public treasury often finds his intellectual honesty sorely strained. More or less fictitious benefits to the community are conjured up in justification of work which ought to stand upon its own merits. The mental processes involved are insidious and the deceiver often ends by being himself deceived." It is a tactical mistake because it fosters a false conception of the relations of science to other pursuits; the continual insistance upon the "practical" justification, especially when this is urged as a basis for the commercial support of research, can only delay the arrival of a social readjustment which, by reducing the grossly disproportionate material rewards of commerce, will help to insure for science the social and

[1] Sumner, F. B., 1917, *Bulletin of the Scripps Instn. Biol. Research*, No. 3, p. 8.

political position it rightfully should occupy. That public eulogists of scientific achievement have rarely undertaken to dwell upon anything beyond the "practical" result argues that there is in them either a want of vision, or a lack of courage to force the consideration of a viewpoint devoid of popular appeal; perhaps both.

W. L. CROZIER

DYER ISLAND

LEAF BURN OF THE POTATO AND ITS RELATION TO THE POTATO LEAF-HOPPER

THROUGHOUT the northern section of the United States, from Montana to New York and south at least to Iowa and Ohio, there has been a remarkable epidemic of leaf burn on potatoes. The margins of the leaves of early varieties turned brown, the dead areas gradually widening until the leaves dried up and the whole field took on a burned appearance. In severe cases the stalks also withered and died.

Every potato section of Wisconsin was affected and a careful study by the writer showed that in every case the injury was directly proportioned to the number of potato leafhoppers (*Empoasca mali* LeB.) present. The nymphs of this species feed on the undersides of the leaves and first produce a wrinkling of the whole surface, with a slight upward rolling of the margin, and then the marginal burning appears. Long after the leafhoppers have acquired wings and flown away it is possible to determine the cause of the damage by observing the cast skins adhering to the under surfaces and the egg scars in the mid rib or veins of the burned leaves.

In cage experiments, using large numbers of leafhoppers, typical leaf burn was produced in four days. The relation of this injury to what has been previously diagnosed as "tip burn" is an interesting subject for future determination. The characteristic marginal burn is frequently so definite that it is possible that there may be something injected that produces more definite and widespread results than the mere mechanical extraction of the sap. There does not, however, seem to be the same specific relation that exists between the beet-leafhopper and the curly-leaf disease of beets.

E. D. BALL

STATE ENTOMOLOGIST,
MADISON, WIS.

"FATS AND FATTY DEGENERATION": A RESPONSE TO BOOK REVIEWS BY BANCROFT AND CLOWES

WILDER D. BANCROFT[1] has recently reviewed in the pages of the *Journal of Industrial and Engineering Chemistry* a book entitled "Fats and Fatty Degeneration,"[2] by Marian O. Hooker and myself. He has also published in his *Journal of Physical Chemistry* a review by G. H. A. Clowes,[3] which in spirit is identical with his own. My attempt to answer both of these reviews in the pages of Bancroft's *Journal* has met with the editor's refusal.

Bancroft and Clowes's adverse criticisms are of two kinds: (1) those contradicting my observations and their interpretation, and (2) those implying unacknowledged borrowings from the works of others, more specifically their own writings. As to the first, it is the privilege of any critic to correct errors and to disprove arguments when truth and logic are on his side; as to the second, no reputable investigator would, even if moved by nothing better than the low ideal of his material future, jeopardize truth by taking it ready-made from another without noting that fact, or would pose as the discoverer of laws already set forth by authorities working in the same field. Those who know either me or the history of emulsion chemistry will easily find their way here. Yet, deferring to another article my answer to the scientific objections of Bancroft and Clowes—an answer that should be apparent to any careful reader of my book—I purpose in this note to comment upon their purely personal criticism.

Bancroft says:

> It is also interesting to note that the author does not cite Pickering's first paper, though he must be familiar with it. . . . It is certainly being overcharitable to say that the author has the unhappy

[1] Wilder D. Bancroft, *Jour. Ind. and Eng. Chem.*, 9, 1156, 1917.

[2] Martin H. Fischer and Marian O. Hooker, "Fats and Fatty Degeneration," New York, 1917.

[3] G. H. A. Clowes, *Amer. Jour. Phys. Chem.*, 23, 73, 1918.

gift of remembering what he has read but of forgetting that he has read it.

This idea is expressed by Clowes as follows:

This statement is somewhat surprising in the face of Pickering's emulsification of 99 per cent. of oil in 1 per cent. of an aqueous soap solution, and Fischer's own data and illustrations (pages 40 and 78) of emulsions (borrowed without acknowledgment from Pickering even to the stick standing up in the jelly) in which 20 parts of oil are emulsified in one part of the water phase.

The scientific aspects of these statements are covered in my book and will be more fully discussed at another time, but the implication of unacknowledged borrowing I can not allow to pass. It happens that I have never had access to this particular paper of Pickering, published, I think, in the *Transactions of the Royal Society*. I believe, however, that I am conversant with Pickering's views on emulsions from such of his papers as have been accessible to me in the original. With regard to the stick inserted in the jelly to test its stiffness, what more boyish means could any investigator employ for such a purpose? Surely he would not need to borrow from a printed illustration so simple an empirical device.

Clowes continues:

In borrowing from earlier investigators the idea of tackling the problem of protoplasmic balance by studying the reversal of phase relations in emulsions, Dr. Fischer failed to make himself acquainted with the data already available regarding the conditions under which emulsions of water in oil may be formed, and emulsions of this type transformed into those of oil in water and vice versa.

Although I do not understand the expression "protoplasmic balance," Clowes evidently believes that I have slighted his work. On the contrary, Clowes's work on the theory of emulsification and his experiments on the transformation of oil-in-water to water-in-oil emulsions are fully acknowledged on pages 28, 29 and 30 of my book. I go so far as to try to harmonize our views, although I must now confess my inability to understand much of his work owing to the fact that he writes diffusely and jumbles good experimental observations with hypotheses. Here as elsewhere, however, I have followed a principle which has guided all my writings, namely, that of discovering and emphasizing only the positive contributions of any author, and of ignoring what seem to me his mistakes or false guesses.

Clowes writes further:

In the chapter on fatty degeneration, Fischer fails entirely to give credit to Alonzo E. Taylor.

This statement is characteristically inaccurate, for Taylor's work is discussed on page 69 of my book. One is tempted to say of Clowes what Bancroft says of me, "It is a little difficult to characterize the author's methods and yet keep within parliamentary limits." Clowes might at least have done me the small justice of looking up Taylor's name in the index. Yet, as a matter of fact, Taylor was interested only in that chemical aspect of the problem of fatty degeneration which asks whether fat may be formed from protein. My own contributions to the subject have nothing to do with this; they deal instead with the physics of the question.

So far as the theory of emulsification is concerned, it is the intent in my volume to show that a union between solvent and lyophilic colloid (the formation of "colloid solvates" or "colloid hydrates") is *one* of the large and important factors in the maintenance of emulsions. This contention of mine is accepted as correct in Bancroft and Clowes's reviews. As a matter of fact the idea is looked upon by them as entirely self-evident, for Bancroft writes:

When oil is emulsified in water by means of a third substance, one has drops of oil each coated by a gelatinous film. . . . If we cut down the water sufficiently we shall get a limiting case where we have merely drops of oil surrounded by gelatinuous films.

Clowes expresses the notion in the words:

Bancroft's demonstration that the formation of one or the other type of emulsion depends not upon the relative volumes of oil and water, but simply upon whether the emulsifying agent employed is preponderantly hydrophilic or lipophilic. . . .

This complete acceptance of my views is both *gratifying* and *surprising*, since neither Bancroft nor Clowes ever said or demonstrated anything of the kind until after the appearance of my various papers[4] and of the book which they review. Never before the time of these reviews has either used the terms "hydrophilic" or "lipophilic" in any of his papers on emulsification. Indeed, when I presented the importance of colloid solvates (Bancroft's "gelatinous films") for the understanding of the stabilization of oil-in-water and water-in-oil types of emulsions, at the 1916 Urbana meeting of the American Chemical Society, both gentlemen attacked my views[5] as impossible. At that time they were following Pickering's belief that the stability of an emulsion depends upon the production of an "interfacial film" between the two liquids which, in Bancroft and Clowes's mind, when bent one way, yielded an oil-in-water type of emulsion, and, when bent the other, a water-in-oil type.

Bancroft says further:

> In so far as an emulsion of oil in water is stabilized by a hydrophilic colloid, there is nothing new about this.

Here Bancroft disparages as not new the very idea which he had previously declared impossible. Of course the fact that emulsifying agents emulsify has been known since mother first made mayonnaise. What mother did not know was why her methods worked. So far as I am aware neither she, nor Clowes, nor Bancroft knew that the hydrophilic properties of colloids were an important element in the matter until I pointed this out.

Clowes concludes as follows:

> While the writer of this review would not charge Dr. Fischer with any deliberate intention to mislead, the obvious haste with which this somewhat pretentious work has been constructed suggests an attempt to skim the cream of a new idea in a promising field of research.

[4] Martin H. Fischer and Marian O. Hooker, SCIENCE, 43, 468, March, 1916; Kolloid Zeitschr., 18, 190, 1916; 18, 242, 1916.

[5] See "Fats and Fatty Degeneration," p. 29, for an account of this.

The statement in the first clause withdraws the whole charge of the critic and is inconsistent with his earlier paragraphs. His succeeding inference is unjustified and absurd. In any case scientific research presents too bounteous a table for those who sit at it to haggle over the cream.

I conclude these quotations with an opinion by Bancroft which reveals his personal animus and embraces not only my volume on fats, but all my books:

> The author's books are all interesting reading, and this one is no exception; but they should be considered as advertising matter in the guise of scientific fiction.

Thus, from his original contention at the meeting of the American Chemical Society that my views are untrue, Bancroft has come to contend that they are not new; and then, insecure upon this ground, he turns from discussing scientific issues and discusses me.

With this brief presentation I rest my case. Decision is, fortunately, not confided to *ex parte* attorneys; it is the portion of disinterested third parties, of science and of time.

MARTIN H. FISCHER

EICHBERG LABORATORY OF PHYSIOLOGY,
UNIVERSITY OF CINCINNATI

QUOTATIONS

A MEDICAL ENTENTE WITH AMERICA

WE published last week an account of the very cordial reception accorded to British medicine in the persons of Sir James Mackenzie, Sir Arbuthnot Lane and Colonel Bruce by the American medical profession during the recent annual conference at Chicago. That event marks an important stage in the development of understanding and sympathy between the two countries, not only because the doctor wields in every community a large if undefined influence, but also because it is well that in the great war against disease which is now in its opening stages the two peoples should stand side by side, mutually supporting one another. American medicine has much to give, and we know that the same can be said of our own profession. The time is opportune for the

cultivation of a closer relationship than has hitherto existed, for the creation of new facilities of study, for the endowment of research fellowships on both sides of the Atlantic, and for the interchange of scientific papers and schemes of work.

Alive to the advantages to herself of a scientific *entente,* Germany before the war used all these means to attract American students to her universities and schools, and to send her students to American schools. A very large measure of success attended her efforts, with the result that not medicine alone, but the sister sciences of chemistry, bacteriology, sanitation and sanitary engineering reaped immeasurable benefits. In this country we have at last awakened to the vast importance of health and of all questions affecting it. Public opinion has demanded that a Health Ministry shall be called into being, and will see to it that the activities of that Ministry, when it comes, are not curtailed in its struggle with disease and ignorance and greed. Public opinion will equally insist that the knowledge gained and progress made by our American friends, who have essayed this task in a broader spirit and at an earlier date than ourselves, are fully utilized, and the support that they may be willing to afford us secured. We shall fight our battle with hands greatly strengthened if we fight it as members of a world-wide community. Disease is international. The hope of the conquest of disease lies in prevention, which must be international as well as local. In this respect no man and no community can say that they live to themselves. A badly constructed drain in a country village contaminating a source of water supply may give rise to an epidemic of great proportions, and this may conceivably be carried by hosts of one kind or another to the world's end. We hope, therefore, that a scientific *entente* will not stop at medicine in the narrow sense of that term. America, for example, leads the whole world in the matter of its milk supply, and our bacteriologists and social workers cannot afford to let the opportunity of help in this direction remain unimproved. Our Ministry of Health, indeed, when formed, will be strengthened in every way by the establishment of friendly relations with the State Boards of Health that have already done so much for America. We are aware that some steps towards the development of such a policy as we suggest have lately been taken, and that other measures are in contemplation. This is satisfactory so far as it goes. But the broadest possible basis of understanding is the best basis in the circumstances, and all branches of scientific work having the public health as their object should take part in the movement.—London *Times.*

SCIENTIFIC BOOKS

Principles of Economic Geology. By WILLIAM HARVEY EMMONS. McGraw-Hill Book Co. 1918. Pp. 598.

There are two recent books with which this at once invites comparison—Lindgren's "Mineral Deposits," and Ries's "Economic Geology." It is not as comprehensive as the latter, for it omits the whole of the important subjects of coal, oil and other fuels. Perhaps for this reason and to avoid confusion in title the word "Principles" is added. To the reviewer the fact that every improvement in transportation or manipulation, like the cyanide process, increases the value of the raw material and consequently lowers the grade of the material which it will pay to work, that there is a tendency to work from small quantities of high-grade material to large quantities of low-grade material, that production is normally in an accelerated ratio, should be classed as principles of economic geology. But it would not be easy for the student to pick out these or any other *economic* principles. The economic data are indeed scanty and not systematic, and there is little or no attention paid to the principles of valuation.

But if the economic side is scantily handled the geologic receives much fuller treatment. In fact twenty-one out of twenty eight chapters are concerned with the classification of ore deposits in general, their structural features and sources. Particularly valuable is the summary prefixed to the earlier chapters on the different types of deposits. Chapters

17 on structural features is also valuable. Mine waters also receive better treatment than they often do. But in his argument for the importance of ascending juvenile thermal waters one might have hoped to see a comparison of the analyses of waters with those which would be obtained from the connate or meteoric waters stimulated in circulation by hot intrusives. There is a lot of sodium carbonate and sulphate in the mine waters of many regions where "alkali" is also characteristic of the surface waters, while the mine waters of other districts are quite different. It may well be that we have a mixture of waters from more than one source, and while the author rightly attributes to precipitation by mixture of solutions an importance which is often overlooked, yet it may have even greater importance.

The range of reference is rather narrow, mainly, though by no means exclusively, to the western United States. In that respect both of the other books are superior. For instance in discussion of the class of zeolitic native copper deposits no reference is made to the work of Weed and Lewis on those of New Jersey, and one might think that Keweenaw Point was unique, except for a footnote reference to White River, Alaska. With regard to the Keweenawan deposits there are a number of minor slips (p. 397). Copper veins are still of considerable importance at the Ahmeek and adjacent mines, nor was the copper obtained from veins formerly, nor at present, wholly or mainly sulphide. It is usually native, sometimes the basic arsenide, and even in the Nonesuch lode one would hardly say that the ore was "chiefly" chalcocite. The Nonesuch mine saved only the native copper. It is noteworthy that there is no such systematic attempt to present diverging points of view fairly as is made by Ries. Compare for instance the treatment of oolitic iron ores in each. This is probably due to the origin of the book as a course of lectures. So, too, while Lawson is referred to, as to his western work, no reference is made to his Lake Superior work. Neither is Allen's declaration that the Animakie is middle Huronian considered. The Keweenawan is classed without a question as pre-Cambrian.

After the extensive treatment of ore deposits, iron, copper, gold, silver, zinc and lead receive treatment in separate chapters, while all the rest of the substances are dismissed in the last hundred pages.

Two relatively new terms are protore: "low-grade metalliferous material not itself valuable from which valuable ore may be formed by superficial alteration and enrichment," and the horsetail structure applied by Sales to divergent minor fractures. Both these seem to be useful.

There is no list of illustrations.

ALFRED C. LANE

Aquatic Microscopy. By ALFRED C. STOKES. Fourth Edition. New York, John Wiley and Sons. 1918. Pp. 324.

The new edition of this well-known guide for beginners retains the general features of the earlier editions. Chapter XII. of the third edition, "Some Common Objects worth Examining," has been replaced by a "Synopsis of the Preceding Chapters," which is a convenient, brief key to the forms described in the book. Minor changes have been made in the text, various scientific names have been modernized, and some of the keys have been extended. The book should continue to be a favorite, not only with the young microscopist for whom it is intended, but with many zoological students and teachers as well who desire to identify quickly and easily some of the commoner aquatic organisms.

M. F. GUYER

UNIVERSITY OF WISCONSIN

SPECIAL ARTICLES

ADAPTATION IN THE PHOTOSENSITIVITY OF CIONA INTESTINALIS

I

Ciona intestinalis of the Pacific Coast[1] re-

[1] These experiments, the details of which will appear later, were performed at the Scripps Institution for Biological Research at La Jolla, California. My thanks are due to Dr. Ritter and his staff for the many courtesies shown me.

acts vigorously when exposed to light. The pigmented ocelli on the oral and atrial siphons are not the sense organs concerned. Stimulation of the ocelli does not result in a reaction, and their removal in no way interferes with the sensitivity of *Ciona*. The receptors responsible for the light sensitivity are localized in the inter-siphonal region in an area corresponding to the neural complex of ascidians. When this spot alone is exposed to light, the resulting effect is identical with the one following total body exposure.

II

The reaction time of *Ciona* to light is composed of two portions. The first is a sensitization period, during which *Ciona* must remain exposed to the light. The second is a latent period during which *Ciona* need not be exposed to the light. At the end of this period it gives its characteristic reaction, though at the moment it is no longer subjected to the source of stimulation. This latent period as found by averaging many determinations on a number of animals at different intensities, is 1.76 seconds.

III

The sensitization period (or roughly speaking, the reaction time) varies inversely as the intensity of the stimulating light. Moreover, the duration of the sensitization period multiplied by the intensity of the light is constant. This means that the amount of energy (time $\times$ intensity) required by *Ciona* for a reaction to light is the same for all intensities. This is a familiar phenomenon in the chemical effect of light (Roscoe-Bunsen rule) and signifies that the light decomposes a constant quantity of photosensitive substance before *Ciona* reacts to light.

IV

When kept in diffuse daylight, this species does not respond to a lower intensity of light. It does react to sunlight. However, if *Ciona* is placed in the dark, it will become "dark adapted" after a time and will respond to an artificial light of as low as 500 candle meters intensity. The investigation of the *rate* at which it becomes "dark adapted" is of considerable interest. This is found by determining the reaction time of an animal to a light of constant intensity at 15-minute intervals in the dark-room. The following is found to be true. At first the reaction time is long, then it shortens rapidly, then slowly, and finally it becomes constant.

The duration of the exposure time multiplied by the intensity of the light gives the amount of energy received. The amount of energy determines the quantity of photosensitive substance decomposed. Therefore, the extent to which the photosensitive material requires to be is changed in order to produce the same reaction during "dark adaptation," is at first large, then it decreases rapidly, then slowly, and finally it becomes constant.

The significance of this rate of change will become apparent when we shall have considered the nature of the photosensitive substance and its mode of formation.

V

Decomposition of the photosensitive material by light, presupposes the formation of this substance within the sense organ. It will simplify matters to assume that the action of the light results in the conversion of the photosensitive material into its precursor. Thus normally, and of course in the dark, the precursor (P) forms the substance (S) sensitive to light. In the light, however, S is converted back into P.

The rate of formation of the precursor from the photosensitive substance in the presence of light, has been shown to be a direct function of the amount of energy supplied by the stimulating light. The occurrence of the reaction in the opposite direction, however, must be considered in terms of the velocities of ordinary chemical reactions. The formation of the photosensitive material from its precursor is probably a reaction of the first order. For our purposes, however, it may be a reaction of even a higher order. Practically all chemical reactions have this in common: the velocity of the reaction is at first rapid, then

it slows down gradually, and finally it reaches a point of equilibrium which represents a definite ratio between the concentrations of the reacting substances.

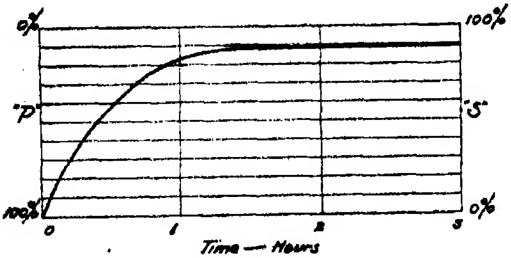


FIG. 1. Hypothetical course of the reaction $P \rightarrow S$ (formation of photosensitive substance) which takes place during dark adaptation of *Ciona*. The regular change in the reaction time during dark adaptation depends on this chemical reaction. The curves expressing this change may be duplicated by plotting a constant fraction (1/10) of the unused P against time as abscissa.

In the case under consideration, the relation between the two substances may be represented in Fig. 1. The ordinates at the right indicate the per cent. of photosensitive substance (S) formed from the precursor (P). The ordinates at the left give the amount of the precursor (P) remaining during the progress of the reaction.

The production of the photosensitive substance in the sense organ of *Ciona* undoubtedly takes place in this manner when the animal is placed in the dark room. It will be seen from Fig. 1 that the amount of the precursor (P) is at first large, then it decreases rapidly, then slowly, and finally it reaches a constant minimum. This is also what happens to the reaction time, and therefore to the amount of photosensitive substance broken down before a reaction can occur during the process of "dark adaptation."

Since it was assumed that the photosensitive material decomposes into its precursor, the amount of the precursor formed at each reaction during dark adaptation, runs, in general, parallel to the amount of the precursor still unused in the reaction. Therefore, in order to serve as an "inner stimulus," the quantity of precursor formed by the stimulating light must bear a definite quantitative relation to the amount already present. This is merely the basis of the familiar Weber-Fechner concept, that the amount of stimulus necessary to produce a perceptible increase in sensory effect represents a constant fraction of the quantity of stimulus that has gone before.

VI

The crucial test of any explanation lies in its ability to predict the course of events. Such a test was applied to the hypothesis suggested above.

We do not know with any accuracy the course of the reaction taken to form the photosensitive substance from its precursor. But the reverse reaction—the formation of precursor from sensitive material—has already been shown to follow the Roscoe-Bunsen rule. Consequently, the quantity of precursor present depends upon the amount of light energy which the animal has recently received.

If a dark adapted *Ciona* is repeatedly exposed to light at sufficiently close intervals of time, only a negligible quantity of new photosensitive material should be formed. The amount of precursor produced by the light, however, will depend entirely upon the total exposure time. Moreover, if it is true that, in order to act as a stimulus, the amount of precursor formed must bear a constant ratio to the amount already present, the reaction time should always bear the same relation to the reaction times that have preceded it.

This is indeed found to be the case. *Cionas* that have been kept in the dark for several hours, and are then exposed to light at intervals of a minute, and their reaction times taken, follow exactly the prediction outlined above. A curve drawn with time as ordinates, and sensitization periods (reaction time minus 1.76 seconds) as abscissas, has a simple logarithmic form corresponding to the usual Weber-Fechner expectation. If instead, the logarithms of the sensitization periods are used as abscissas, the resulting curve is a straight line. This indicates that the amount of energy required to produce a reaction at any stage in the repeated stimulation is a con-

stant fraction of the amount of energy which the sense organ has received previously.

VIII

Repeated stimulation of the kind just described, has frequently been called a process of adaptation to a stimulus. As such it has been used as a criterion for the presence of a "higher behavior" in many animals. Similarly, the fact that the reaction time continues to increase steadily has been taken to indicate a process of learning.

The experiments forming the basis of this communication, have, however, shown that these phenomena are dependent on changes which take place within the sense organs themselves. In addition, they have demonstrated that the process of "adaptation" to a photic stimulus in *Ciona* is subject to the course of a chemical reaction. The reverse of this reaction determines the ability of the organism to become "dark adapted." Furthermore, the changes which occur in the reaction time during both of these adaptional processes are consistent with the principle underlying the Weber-Fechner rule. This requires that in order to act as a stimulus, the light must form a quantity of a substance such that it will bear a definite ratio to the amount of that substance already present in the sense organ. The matter of "higher behavior" is nowhere evident in these experiments.

Selig Hecht

Physiological Laboratory,
Creighton College of Medicine,
Omaha, Nebr.

A METHOD FOR PREPARING PECTIN

Pectin bodies is a term applied to a group of substances occurring in practically all plants and fruits. They are complex carbohydrates, probably derived from one mother substance known as pectose, and are closely allied to the plant gums and mucilages. Pectin occurs most abundantly in the apple, quince, currant and gooseberry and appears in small quantities in strawberries, raspberries, etc. In suitable amounts of sugar and acid the pectins have the property of gelatinizing fruit juices or hot-water extracts of fruit pulp in which they are present or to which they may be added. The reason why some kinds of fruit juices do not jelly is due to an insufficient amount of pectin being present in them. For example the practise of mixing apple juice with raspberry or strawberry juice is for the purpose of increasing the pectin content and thereby make jelly from juices where it would be impossible to do so otherwise. The juices from the various kinds of fruits are known for their distinctive flavors. These qualities are impaired when a combination of juices are blended together. For this reason it has been the aim of manufacturers to make high-grade jellies from the low-containing pectin fruit juices by adding to them the purified pectin. The pectin, as now prepared, is very expensive and therefore its use in jelly-making is very limited.

Pectin is slightly soluble in water and therefore the pulp or pomace resulting from the pressing of ripe fruit contains practically all of the pectin. Hot water will slowly extract the pectin and for this reason fruits are cooked to a pulp with water before extracting the juice for jelly-making.

In the fruit-producing sections of the state of Washington, there is a considerable amount of cheap material such as cull apples, pomace from cider presses and cores and peelings from canning establishments which go to waste. This waste material might be utilized for the preparation of pectin which, in turn, could be used in making jelly from those fruit juices which lack pectin. The object of the experiment carried on in this laboratory was the finding of some simple and inexpensive process for the preparation of pectin from these waste products, without the use of alcohol, as is the case in Goldthwaite's[1] method.

The principle of the method is based upon the fact that pectin as extracted from the pulp or pomace is in a colloidal state and can be readily changed by electrolytes. Since pectin, after precipitation, must be dispersed again in order to be of any value as a gelatinizing agent, an electrolyte that will produce a reversible precipitation must be chosen. Also

[1] *J. Ind. and Eng. Chem.*, 2 (1910), 457.

the electrolyte chosen must be non-poisonous. Lead acetate or basic lead acetate will precipitate pectin, but the precipitation is an irreversible one, and the amount of lead absorbed or combined may be poisonous. For these reasons ammonium sulfate was chosen. Bigelow, Gore and Howard[2] in their review of the literature on pectin mention that in 1898 Bourquellot & Herissey used ammonium sulfate as a precipitant for pectin obtained from gentian root. Other than this no further use has been made of this precipitant for pectin.

METHOD

60 grams of dried apple pomace were boiled three successive times with 200 c.c. of water, filtering after each boiling. To each of the 100 c.c. of filtrate 25 grams of ammonium sulfate were added[3] and then heated to 70° C., whereupon the pectin was precipitated as a grayish white flocculent precipitate. The precipitate was separated from the mother liquor by filtering. (The mother liquor can be evaporated and the residue used again or the residue can be used as a fertilizer.) The precipitate was dissolved in hot water and again precipitated with ammonium sulfate. Again it was filtered and the precipitate was removed from filter paper and dried at 60–70° C. and when dry was washed several times with cold water to remove adhering ammonium sulfate. The precipitate was dried again and its gelatinizing power was tested by adding to a 1 per cent. solution of the pectin 0.5 per cent. solution of citric acid and 65 gm. of sugar. This solution was boiled for 10–20 minutes and upon cooling a nice stiff jelly was produced. The taste did not indicate the presence of ammonium sulfate and upon dissolving the jelly in hot water only a slight milkiness was produced when tested for sulfates.

In order to determine whether the yield of pectin by the above method was equal to the yield produced by the alcohol precipitation method, two samples of apple pomace from the same lot were treated exactly alike, except that ammonium sulfate was used in one case and alcohol in the other as the precipitating medium. The pectin was dissolved and reprecipitated in each case, then filtered and the precipitate was removed from filter paper and dried. The ammonium sulfate was removed from the one by washing with cold water, again dried and weighed. The amount of pectin recovered by each method is recorded in table below.

Precipitant	Pectin, Per Cent.
Ammonium sulfate	6.33
Alcohol	6.91

The amount of ammonium sulfate used can be reduced by concentrating the extract, either by evaporating on a steam bath, in a partial vacuum or by freezing.[4] The quality of the pectin is not impaired in either case.

SUMMARY

Pectin can be prepared by adding ammonium sulfate to the hot water extract of fruit, and heating to 70° C. The amount of pectin recovered is practically equivalent to that recovered by the alcohol precipitation method.

Concentrating the pectin extract below the boiling point did not impair the quality of the pectin.

Chas. H. Hunt
Washington Agric. Experiment Station,
Pullman, Wash.

[2] Bul. 94 U. S. Dept. Agr. Bur. Chem.

[3] If wet pomace is used it will require a somewhat larger amount of ammonium sulfate. First add 25 grams per 100 c.c. and if precipitation does not occur, add successive portions of 5 grams until precipitation occurs. The pectin may also be precipitated by saturating the solution in the cold with ammonium sulfate.

[4] J. S. Caldwell, Bul. 147, Wash. Agr. Exp. Sta.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

Friday, August 30, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

SPHAGNUM AS A SURGICAL DRESSING[1]

The world war has produced a "world emergency" which has stimulated to an extraordinary extent the inventive genius of this and practically all nations. This is observed not only in the great development of destructive agents as seen in certain lines of chemistry, aeronautics, submarines and gunnery, but also in the marvelous skill that has developed and the appliances used in surgery. War had been declared only a few months when it was seen that there was likely to be a shortage of absorbent cotton, and in an effort to avert such a calamity experiments were begun with sphagnum, or peat moss, as a substitute. At the present time surgical and non-surgical dressings made from sphagnum are being used in the war hospitals, not only in Great Britain, but in France, Malta, Alexandria, Salonika, Italy and Palestine—practically on all the allied fronts. Doubtless it is also used extensively in Germany, as certain returned prisoners state that part of their work was to gather sphagnum from bogs. How it was used, however, we do not know.

DISTRIBUTION OF SPHAGNUM

Sphagnum is widely distributed throughout the world, especially in the damp humid climate of the colder parts of the temperate zone of Europe, Asia and America. The British supply comes from the moors of Scotland and Ireland, and from Canada. The Germans obtain it from extensive bogs around the Baltic.

In North America it occurs most commonly along the northeastern coast from New England to Labrador, and along the northwestern coast from Oregon to Alaska. In the interior large bogs occur, especially in the region

[1] A fuller account of "Sphagnum as a Surgical Dressing" is given by the writer in a pamphlet published by the Northwest Division of the American Red Cross, Seattle, Washington.

of the Great Lakes. Thus far, however, moss suitable for surgical dressings has not been reported in any large quantities from this region. The excessive heat in summer and the extreme frost in winter creates a condition that is uncongenial for desirable species to grow and thrive.

On the Pacific coast, extending from Oregon to Alaska, large numbers of sphagnum bogs occur. It is estimated that in Washington alone there are 25,000 acres of cranberry marsh. Of course a large proportion of this area does not have usable moss. Most of the bogs in Washington that are close to the Pacific Ocean are "raised bogs," that is, the center is higher than the margin, often a foot or more. Consequently, surrounding each of these is a marginal ditch filled with water. Raised bogs also occur along the northern Atlantic, especially in Nova Scotia and Newfoundland. This type of bog occurs only where there is an excessive amount of moisture and thus most congenial for the growth of sphagnum. Moreover, it is this kind of bog that usually contains the species most suitable for surgical dressings. Hence the most promising fields for the location of suitable surgical moss may be expected along the northern Atlantic and Pacific coasts.

USES OF SPHAGNUM

Sphagnum is frequently called "peat moss," because it, with other plants growing in undrained bogs, eventually make peat, which is used extensively for fuel in some countries. Sphagnum is very commonly used by nurserymen and others for packing; especially is it desirable about the roots of plants when moisture is required for a considerable length of time. A number of varieties of orchids thrive as well in sphagnum as in their native haunts. This moss makes an excellent insulator, much better than sawdust or even cork, but of course it can not be used where it is exposed to moisture. It excels sawdust as a medium for packing and shipping raw fruits, like grapes, because when one bunch "goes bad" the moss immediately absorbs the moisture and prevents the infection spreading. In Sweden some of the coarser kinds of paper, like wall-paper, wrapping paper and building paper, are made from this moss. It is used in Alaska and other places where it is abundant to bind up wounds of domestic animals, particularly when there is some discharge. In such cases the moss is applied directly to the wound. When it is dried it is often used as bedding for horses and other animals. This moss has also been used in Scotland and Ireland as a home remedy for absorbing the discharge from boils and other suppurating wounds. The American Indians made use of dried sphagnum for diapers for their babies. In Alaska they still do it. The Alaska Indians also make a very wholesome salve, used for cuts, by mixing sphagnum leaves with tallow or other grease and working the two well together.

It is known that in Germany a fairly good cloth is made by mixing sphagnum with wool and weaving them together. Promising results have also been obtained when it is used as a fertilizer. Not that it adds much plant food to the soil, but that it acts as a stimulant by holding a large quantity of water. It is of particular value when applied to the roots of trees along parking strips in cities.

Dr. Walton Haydon, of Marshfield, Oregon, used sphagnum extensively while in the service of the Hudson Bay Company at Moose Factory during the years 1878–1884. After the moss was collected and sorted it was sprinkled with a weak solution of carbolic acid. When nearly dry it was stored in a jar with a tight cover until used. In using it a thin cotton dressing was laid on the wound or sore, then a layer of moss and the whole dressing wrapped with a bandage. Dr. Haydon found it best to keep the sphagnum with a small amount of antiseptic moisture in it, as it breaks up and becomes dusty when thoroughly dried.

Sphagnum was used or at least recommended for use during both the Napoleonic and Franco-Prussian wars, and was employed to a limited extent in the Russo-Japanese war. It was not, however, until the present world

war broke out that it became extensively employed as a modern surgical dressing.

Shortly after the war was declared in 1914, Dr. C. W. Cathcart, an Edinburgh surgeon and a lieutenant-colonel in the medical corps of the British army, began experimenting with sphagnum in one of the Scottish hospitals. The first published account of these experiments, together with the general account of the moss as a surgical dressing, appeared in the *Scotsman* of November, 1914.[2] Dr. Cathcart then formed an organization for collecting and preparing the peat moss for surgical pads in Edinburgh. This was the first organization formed for this purpose among the allied nations. In September, 1915, a second one was established in the south of Ireland by the Marchioness of Waterford. The work thus begun was so promising that new organizations sprang up all over Scotland and Ireland under the War Dressing Supply Organization in Edinburgh, and the Irish War Hospital Supply Depot in Dublin. During this experimental stage there was considerable opposition to this kind of surgical pad, but as time went on and the method of making the dressings was improved, this opposition disappeared and in February, 1916, the British War Office accepted them as "official" dressings. With this recognition and organization the work rapidly increased, so that during the summer of 1918 the sphagnum pads produced by Great Britain are numbered in the millions per month, Scotland alone being asked to supply 4,000,000 sphagnum dressings a month.

In America the sphagnum work on a large scale, has been more recent. During the summer of 1916, Dr. J. B. Porter, of McGill University, became interested in peat moss for surgical dressings.[3] Samples were collected in eastern Canada, especially in Nova Scotia, and sent to Britain for approval. It was late in the season before definite reports could be obtained from these samples, so little was done before the bogs were frozen.

In the spring and summer of 1917 this work was continued by the Canadian Red Cross under the direction of Dr. Porter. Although no very large number of dressings was made, yet the organization was extended and perfected, and the bogs containing the desirable moss located, so that if the demand became more urgent the production of this kind of dressing could be readily pushed. This demand came in January, 1918, in the form of an order from the British War Office, for 20,000,000 sphagnum surgical dressings. The Canadian Red Cross is thus doing extensive work along this line during 1918.

After the United States entered the war more interest was taken in this work by Americans but it was not until March 1, 1918, that sphagnum was officially recognized by the National Red Cross of America. At that time a preliminary order for 50,000 pads was given to the Seattle Chapter and these have been made on the campus of the University of Washington under the direction of the writer.

The faculty of the University of Washington, feeling the importance of this phase of War Emergency work and wishing to assist in completing as rapidly as possible this large allotment of pads, voted to require all women of the first and second years of the university to register for two hours a week for moss work during the spring quarter. The request for this work came originally from the women themselves through the dean of women. They felt that since the men were required to devote eight hours a week to military drill without university credit, the women also should do some definite war work under university supervision.

COLLECTING AND SORTING

Before beginning the collection of sphagnum one should know exactly what is needed. There are over forty species of this moss in America of which only four (*S. imbricatum*, *S. palustre*, *S. papillosum* and *S. magillanicum*) are at present used for surgical dress-

[2] Charles W. Cathcart and I. Bayley Balfour, "Bog Moss for Surgical Dressings," *The Scotsman*, No. 17, 1914.

[3] John B. Porter, "Sphagnum Surgical Dressings," *International Journal of Surgery*, May, 1917.

ings. Great care should thus be exercised in order that only suitable moss be collected. To this end it is often wise to carry a sample of approved sphagnum for comparison until one is quite familiar with the work.

In the bog it has been found most convenient to take a small handful of moss at a time and to shake it lightly to get rid of most of the foreign matter, such as leaves, twigs, roots, etc. If wet, squeeze out as much water as possible before putting it in the bag, but do not wring it, as that will break and injure the stem.

The depth to which usable moss extends varies with the species and environment. In many cases beds of *Sphagnum imbricatum* may be worked to advantage a foot to eighteen inches or even farther, depending on whether the plants remain intact or whether a partial decay has begun. In general, whenever the plants begin to break up as a result of the first stages of decay, they must be discarded; but as long as they remain intact, with stem fairly well crowded with lateral branches, they may be used, the color playing little or no part in determining the suitability. While gathering moss it is wise to secure all the good moss in a given space before proceeding to another, because after a growth has once been disturbed the adjoining plants usually deteriorate and sometimes die.

After it is taken from the bog the moss should be removed to some shelter and spread out to dry. This may be done on the grass if the weather is fine, otherwise on suitable racks which usually prove more satisfactory, or on the floor of some empty building, although care must be taken not to put it on valuable flooring, as the dampness is apt to do some damage.

The collection of moss is one of the most important phases in the making of sphagnum pads. Much depends upon the condition of the moss when it reaches the sorter if their work is to be most efficient. It has been found that carelessness or thoughtlessness on the part of the collector often decreases the efficiency of the sorter far out of proper proportion.

The most tedious part of making sphagnum pads is picking over and sorting the moss, and this is greatly increased by careless gathering. The sorting should be done in some central place and completed before the moss is dry. If inadvertently the moss becomes too dry it should be spread out in a gentle rain for a short time or sprinkled with water and left over night with an oil-cloth spread over it.

HOW SPHAGNUM PADS ARE MADE

Like many other things in connection with this war, the directions for making surgical dressings from sphagnum have not been static, but progressive. From time to time valuable suggestions as to where the pads could be improved have been received from surgeons at the front who have been actually using them. Acting on these suggestions, the British have gradually increased the efficiency of their moss dressings. More recently the American Red Cross, after some experimentation under the direction of Dr. John A. Hartwell, has adopted a different dressing which promises to be even more efficient than the one authorized by the British War Office. But the last word has not yet been said on sphagnum for surgical dressings. The American type of sphagnum dressing is composed of gauze, a thin sheet of wood pulp paper, non-absorbent cotton and sphagnum. The sizes of the dressings will vary from time to time as the War Department may recommend. The first half million pads allotted to the Northwest Division of the Red Cross consists of two sizes, 8 in. by 12 in. and 12 in. by 24 in.

In making one of these dressings, a piece of Zorbik or Scott tissue[4] of appropriate size is placed on the table and on it a wooden frame corresponding to the particular size to be made. The frame, which is about three quarters of an inch deep, is filled evenly with moss over which a thin layer of non-absorbent cotton is placed and then the frame removed. The margins of the tissue are then folded over the cotton and sphagnum. It is usually convenient to use spring clothes-pins to hold

[4] Zorbik or Scott tissue is a very thin wood-pulp paper used to envelop the sphagnum and prevents it from sifting out.

the ends in place, although this is not absolutely necessary. In order to keep the outside covering free from particles of moss it is best to remove this incomplete pad to another table where there is no moss. Here it may be finished by the same worker or by another. A piece of gauze of appropriate size is spread out on the table and the incomplete pad is placed in the center of it, with the non-absorbent cotton up. A thicker layer of cotton is then put over the pad, extending about a quarter of an inch beyond the edges. The gauze is folded over the pad so that the long fold is on the back, that is, on the side next the non-absorbent cotton.

The open ends are folded in "muff-wise," first folding the under side up over the tissue-envelope, then folding the upper side to correspond and adjusting the "muff-end" carefully. The pad is patted lightly to make sure the sphagnum is evenly distributed throughout and then passed through a clothes-wringer. If, when held up to a strong light, "holes" are detected in the pad, too little moss has been used. If the pad is solid and harsh, there is probably too much moss.

The British type of sphagnum pad consists of a flat bag made of English long cloth with a fine enough weave so that the particles of moss will not sift through. This bag, which varies in size according to the need, is filled with the appropriate amount of moss and sewn up.

The Canadian Red Cross adopted three types of sphagnum dressings, the British type just mentioned, a standard dressing similar to the American type and bed pads made of second grade sphagnum. During the summer (1918) the Canadians are concentrating most of their energy on the standard dressing, while a smaller number of the British type and comparatively few of the bed pads are being made.

SUMMARY

1. The use of sphagnum as a substitute for absorbent cotton is not only a great saving of money but is fast becoming an absolute necessity on account of the acute shortage of cotton, due, in part, to the extensive use in explosives.

2. It has been estimated that if absorbent cotton were used exclusively in the hospitals the cost would be not less than $200,000 per annum for Great Britain alone, while the cost of the moss is practically negligible.

3. The value of sphagnum as a surgical dressing lies chiefly in its absorbency. The species used for this work will absorb and hold fourteen to twenty times their weight of water. Ordinary absorbent cotton will hold only four or five times its weight.

4. The sphagnum is not subjected to any special treatment for surgical dressings but simply gathered from the bog, the foreign material removed, dried and made into pads which are sterilized after they get to France.

5. There is some indisposition on the part of American surgeons in France to use these pads. This is what was anticipated as surgeons are, to say the least, conservative in connection with their supplies, etc., and generally speaking indifferent as to the expense of these supplies. The British Army Medical Service went through the same thing two years ago and even up to last year sphagnum dressings were looked upon as an undesirable make-shift by a great many British surgeons; but at last they seem to have come into their own, as can perhaps best be illustrated by the fact that Canada has been given an allotment of 20,000,000 and that Scotland has been recently asked to turn out 4,000,000 sphagnum dressings a month.

6. Although sphagnum for surgical dressings has been largely the result of the present war, a make-shift for a necessity that had arisen, yet there seems every reason for believing that it is not going to be discarded after the war ends. The inexpensiveness of the moss, its high absorbency, its abundance in certain parts of the country and its undoubted superiority over gauze and absorbent cotton for some purposes, clearly indicated that it is too important as a hospital equipment to let die with the war. When the war is over it will probably take its place among the regular commercial products called for by modern hospitals.

7. The last word has not yet been said regarding sphagnum for surgical work. Ex-

periments are constantly going on, looking towards both the improvement in these dressings and also in the extension of the usefulness of sphagnum along other lines.

J. W. Hotson
The University of Washington,
Seattle, Wash.

A NEW SEASONAL PRECIPITATION FACTOR OF INTEREST TO GEOGRAPHERS AND AGRICULTURISTS

Most persons who have attempted to correlate soils and vegetation with atmospheric precipitation have directed their attention chiefly to the total annual rainfall and its variations from place to place.[1] It has long been recognized that seasonal distribution also needs to be taken into consideration, but there has been no unanimity as to how seasonal variations of rainfall should be treated. Some have simply mapped the total precipitation for each month or season separately, or indicated the months of maximum rainfall in different regions; but a more common method has been to map the percentage of the total occurring in the six middle months of the calendar year, April to September inclusive.[2] Such an arbitrary division is rather unscientific, however, for in the eastern United States, if not throughout the northern hemisphere, the warmer half of the year usually extends from the latter part of April to the latter part of October, so that May to October inclusive would more nearly represent it.[3] The use of the earlier period has been defended on the ground that April rain is more beneficial to crops than October rain, which is probably true (and so would March rain be better than September rain); but the type of rainfall that is best for crops, other things being equal, is not necessarily best for soil in the long run. A warm rain presumably has a greater leaching effect than cold rain or snow, and regions subject to heavy summer rains, like most of Florida, generally have poorer soils and more swamps than where the summers are dry, as in California.[4]

In recent years the writer has calculated the rainfall percentages for May to October and also for June to September for numerous stations in the southeastern states, and thereby shown some interesting correlations with soil and vegetation.[5] But when these factors are mapped for the whole United States the correlation does not work out so well. For the northern part of the Great Plains has about the same proportion of its total rain in summer as peninsular Florida, but very different soils and vegetation. Of course part of the difference is due to the fact that the total rainfall and average temperature are much less on the Plains than in Florida. But there is another important climatic difference.

In the Great Plains and much neighboring territory the bulk of the rain falls in early summer, while along the Atlantic and Gulf coasts there is generally more rain in late summer than in any other equal period. Consideration of this fact recently led to some comparisons between early and late summer rainfall for the whole United States. After some experimenting it was found that the most striking results were obtained by taking the difference between the rainfall for April to June inclusive and that for August to October inclusive,[6] the former being good for the

[1] For such correlations between soil and rainfall see Bulletin 3 of the U. S. Weather Bureau, by E. W. Hilgard, 1892. A review of this, which may be more accessible than the original, can be found in the *Experiment Station Record*, 4, 276–282, October, 1892.

[2] For a map of the United States on this principle see Plate 2 in U. S. Geological Survey Water Supply Paper 234, 1909.

[3] See *Geol. Surv. Ala. Monog.* 8, 24; *Bull. Torrey Bot. Club*, 40, 395, 1913.

[4] Dr. A. D. Hall, of Rothamsted, in an address on agricultural extension problems published in the *Popular Science Monthly* for October, 1914 (p. 349), says: "Winter rain is more valuable than summer."

[5] See *Bull. Torrey Bot. Club*, 37, 415–416; 40, 395; 41, 556–557; *Geol. Surv. Ala. Monog.* 8, 19 24, 36, 1913; *Fla. Geol. Surv. Ann. Rep.*, 6, 182–184, 1914; also Ward in *Bull. Am. Geog. Soc.*, 46, 47, January, 1914.

[6] If climatological data for fractions of months were available we could include the first half of July in the early summer period and the second

crops and the latter bad for the soil. Data for a few hundred stations were taken from Bulletin Q of the U. S. Weather Bureau, which although it brings the records down only to the end of 1903, and contains a few typographical errors in the figures, is easier to handle than any later publication covering the same ground, and is probably accurate enough to base a working hypothesis on.

The resulting map differs considerably from any other precipitation map, but instead of publishing it in its present imperfect state a brief description will be given. The line of equilibrium, where there is no difference between early and late summer rainfall, crosses the St. Lawrence River in northern New York and extends in a general southwesterly direction, with various sinuosities (perhaps due largely to differences in altitude and exposure between neighboring weather stations in the Appalachian region) to the vicinity of New Orleans, thence westward, passing between Houston and Galveston, to near Del Rio on the Rio Grande, northwestward across the Staked Plains to the Rocky Mountains in Colorado, westward to Monterey County, California, and then southeastward just back of the Coast Ranges into Mexico. Another part of it separates the northern half of Michigan, northeastern Minnesota, and part of Wisconsin from the states to the southward, then passes northwestward into Canada and dips back into the United States just enough to cut off the north end of Idaho and the northwest corner of Washington. The borders of the United States are mostly in the region of late summer excess, while approximately three fourths of the country, including almost the whole area drained by the Mississippi River, has an early summer excess. The greatest late summer excess, about 11 inches, is on the east coast of Florida,[7] and the mouths of the Mississippi and Rio Grande are not far behind. The Black Hills have an early summer excess of about 6 inches, and the area having more than 4 inches extends all the way from Montana to Alabama. If ratios instead of differences had been used the position of the zero line would have remained the same, but the gradient would have been steepened in the drier parts of the country.

The map here described suggests at once some very interesting correlations. Considering other climatic factors first, nearly all our tornadoes occur in the region of considerable early summer excess of precipitation, and our hurricanes in that of considerable late summer excess, while regions where the difference is not more than an inch or two either way rarely suffer much damage from wind. Both tornadoes and hurricanes usually occur during the period of greatest rainfall in their respective regions.[8]

The late summer rains commonly come in the form of showers in the daytime, while the

half in late summer, and perhaps get still greater contrasts.

[7] Nassau in the Bahamas, about 180 miles farther east, has a late summer excess of nearly 13 inches.

[8] There is a tornado frequency map of the United States by J. P. Finley in Professional Paper No. 7 of the U. S. Signal Service (1882), reproduced on a smaller scale with fewer details by R. DeC. Ward in *Quart. Jour. Roy. Meteorol. Soc.*, 43, 323, 1917. This is based on 600 tornadoes occurring between 1794 and 1881, but is a little misleading, because in the early part of that period the regions where tornadoes are most frequent were practically uninhabited by civilized man, and thus the apparent frequency of such phenomena in the older states is exaggerated. Of the 40 tornadoes prior to 1850 reported by Finley, 9 were in New York, 5 in Ohio, 3 in Connecticut, 3 in Georgia, and none in Kansas and Illinois, which now lead the list. A map based on records from about 1870 to date would be more accurate; but even Finley's map shows a fair degree of correspondence between tornadoes and early summer rainfall excess.

It appears from Bulletin X. [not 10] of the U. S. Weather Bureau, on Hurricanes in the West Indies, by Dr. O. L. Fassig (1913), that there are only three well-marked hurricane regions in the northern hemisphere, all lying between latitudes 5° and 30° N., and all having a maximum storm frequency in September. In the United States hurricanes are most frequent in Florida, but they are occasionally felt as far north as the coast of Massachusetts.

early summer rain is more likely to fall gently, and at night. In the southwestern semi-arid late summer rain area (*i. e.*, Arizona, New Mexico and adjacent territory) the railroads have been put to considerable expense to build dikes to protect their tracks from sheet-floods following summer showers, while in northern Nevada and Utah, where the total precipitation is about the same, but its seasonal distribution different, no such precautions seem to be necessary. Floods of the ordinary type, caused by overflowing rivers, are much more frequent and destructive in the region of early summer rains, however.

If there was such a thing as a soil fertility map of the United States it would be seen at once that the most fertile soils are in the region where there is more rain in early summer than in late summer, and vice versa. Considering texture only (for we now have much more complete data on that than on chemical composition), we can ascertain from published soil surveys that silt loam—which is usually considerably above the average in fertility—is one of the commonest types of soil throughout the Mississippi valley, whether it is derived from weathered Paleozoic rocks, as in Tennessee, from glacial drift, from glacial lake deposits, as in North Dakota, or is of æolian origin, as the loess of Arkansas and Mississippi is supposed to be. Clay loam and stony loam are other common types in the same area, nearly or quite as fertile as the silt loam, while sand is chiefly confined to the banks of streams. The black prairies of Alabama and Texas, characterized by very fertile calcareous clays, are both in the area of early summer excess of rain, although when semi-annual percentages only were considered, as heretofore, the line of equal summer and winter rains passed between them. One would naturally suppose the flood-plain of the Mississippi below the mouth of the Ohio to be one of the most fertile tracts in the world; and so it is where it has more rain in early summer than in late summer, and most of the farmers in that portion use no commercial fertilizer whatever. But in several parishes below New Orleans, where the late summer rain is in excess, the average expenditure for fertilizers in 1909 was over a dollar per acre of improved land! (For the whole United States at the same period the average was about 24 cents.)[9]

The regions of heavy late summer rain are characterized by poor sandy soils, classed by the U. S. Bureau of Soils as sand, sand-hill, sandy loam, fine sandy loam, etc., and silt loam and clay are comparatively scarce. The sandiest extreme is in peninsular Florida, but northern Michigan, Cape Cod, and southern Texas are also notoriously sandy. Swamps too are about as prevalent in northeastern Minnesota and northern Michigan as they are in Florida. Although the late summer rain area covers only about one fourth of the United States and produces considerably less than one fourth of the crops, it uses at least three fourths of the commercial fertilizer; the average annual expenditure for that in some of the southeastern counties of Florida at the time of the Thirteenth Census being about $30 per acre.[10] And even in California there is considerable fertilizer used in the southeastern portion.

In all these eastern sandy and swampy areas the streams carry very little sediment and do not fluctuate much. In the corresponding parts of the Southwest there is not so much sand, but the type of soil known as adobe (and used extensively for building material) is very characteristic.

The distribution of vegetation types is of course correlated with the soil to a considerable extent. Except in the Northwest the forests of the early summer rain area are composed almost wholly of deciduous trees, and there are vast areas of prairie; while conifers, especially pines, predominate in northern Wisconsin, Cape Cod, southern New Jersey, Florida, and many other places where there is more rain in late summer. The most extensive pine forests in North America are said by Professor Sargent[11] to be those of western

[9] In this connection see SCIENCE, II., 42, 500–503, October 8, 1915.

[10] See *Geog. Review*, 4, 225, September, 1917.

[11] "Manual of the Trees of North America" (1905), p. 16.

yellow pine in northern Arizona and New Mexico. Most of the cacti in the United States are restricted to the southwestern area of late summer rains, and the same might be said of the species of *Yucca* and related genera.[12] (Both groups consist entirely of evergreens, and both have also several representatives in the Southeast.) The gymnosperms other than conifers (*i. e.*, Taxaceæ, Cycadaceæ, Gnetaceæ), as well as the palms and Ericaceæ, show a somewhat similar preference for late summer rain, in the United states at least.

The same precipitation factor seems to control indirectly several economic features. For example, most of the developed water-powers in the United States are within two or three hundred miles of the line of equilibrium between early and late summer rains, though this may be chiefly because the same topographic factors that make the water-power possible also influence the seasonal rainfall in some way. Some correlations between seasonal rainfall and crops are easily made. Alfalfa, wheat, figs and upland cotton are not raised much where the late summer rainfall exceeds that of early summer by more than three inches, while sugar-cane, pineapples, grape-fruit and sea-island cotton thrive where late summer rains prevail. But of course the soil has a great deal to do with this too.

It would be interesting, and comparatively easy, to determine how far the same seasonal precipitation factor can be correlated with soils, vegetation, etc., in other parts of the world. The explanation will not be quite so easy, for cause and effect are involved in a complex manner. Some of the marked soil differences between the Mississippi valley and the Atlantic coastal plain can be explained very well on geological grounds, wholly independently of modern climatic factors; and it may be that the deciduous forests and prairies that characterize the richest soils are conducive to early summer rains, and *vice versa*, in some way not yet understood.

The factor here discussed probably does not have exactly the same significance in cold as in warm climates, in humid as in dry, or in regions of wet winters and dry summers, like the Pacific coast, as in regions with wet summers, like Florida. All this deserves further investigation; and it may be found that by shifting a little the periods compared more significant results can be obtained.[13]

Roland M. Harper

College Point, N. Y.

[12] See Plate 99 in the 13th Annual Report of the Missouri Botanical Garden, 1902.

[13] The interested reader would do well to consult Professor R. DeC. Ward's paper on rainfall types of the United States, in the *Geographical Review* for August, 1917, and some of the earlier literature referred to therein and in the two pages following it.

PLANS FOR THE PHYSICAL RECONSTRUCTION OF DISABLED SOLDIERS[1]

The Surgeon-General, with the approval of the General Staff, announces the completion of plans for the physical reconstruction of disabled soldiers in the general military hospitals. These plans are formulated with a view to close cooperation with the War Department committee on education and special service in the work of restoring men to full or limited military service, and with the Federal Board for Vocational Education, which is authorized by the law to provide vocational training for disabled men after their discharge from the army and navy.

The records of 516 cases treated in four hospitals shows 134 men able to return to full military duty, 210 fit for limited service, and 172 who are eligible for discharge. In the last group 12 are classed as helpless or institutional cases; 121 are able to return to their former occupations; and 39 will need further training to fit them for earning a livelihood. These figures show the division of responsibility in the work of reconstruction.

The task of fitting men for further military service is at present the most pressing need because wherever an able-bodied man behind the lines can be replaced by one less fit physically, but vocationally capable, a soldier is gained for active duty. The reconstruction work in the hospitals, therefore, will emphasize tech-

[1] Publication authorized by the War Department.

nical training in all lines capable of adaptation to the physical limitations of disabled men and in which employment will act as a therapeutic agent. When play and work and study will help a man to get well, this kind of medicine will be prescribed to the patient. If the work he does leads to further service in the army or to better prospects in civilian life so much the better.

The Surgeon-General has designated the following general military hospitals for the work of physical reconstruction:

Walter Reed General Hospital, Washington, D. C.

General Hospital No. 2, Fort McHenry, Md.

General Hospital No. 3, Colonia, N. J.

General Hospital No. 6, Fort McPherson, Ga.

General Hospital No. 7, Roland Park, Baltimore (for the blind).

General Hospital No. 8, Otisville, N. Y.

General Hospital No. 4, Fort Porter, N. Y.

General Hospital No. 9, Lakewood, N. J.

General Hospital No. 11, Cape May, N. J.

General Hospital No. 16, New Haven, Conn.

General Hospital No. 17, Markleton, Pa.

Letterman General Hospital, San Francisco, Calif.

United States Army Hospital, Fort Des Moines, Iowa.

Plattsburg Barracks Hospital, Plattsburg Barracks, N. Y.

General Hospital, Fort Bayard, N. Mex.

The policy to be followed in these hospitals, as announced by the Surgeon General, is that hereafter no member of the military service disabled in line of duty, even though not expected to return to duty, will be discharged from service until he shall have attained complete recovery or as complete recovery as may be expected when the nature of his disability is considered. In furtherance of this policy, physical reconstruction is defined as complete mental and surgical treatment carried to the point of maximum functional restoration, both mental and physical. To secure this result all methods recognized by modern medicine as conducive to cure will be utilized. In other words, not only the ordinary means of medicine and surgery, including all specialties, will be utilized, but also physical measures such as are employed under physiotherapy, including hydro, electro and mechanotherapy, active exercises, indoor and outdoor games and passive exercise in the form of massage. Provision in the form of adequate buildings and equipment for physiotherapy have been adopted in each of the hospitals.

Modern medicinal treatment does not end with physical cure. Functional restoration is the final aim of the modern physicians and surgeons. It is conceded that the physical rehabilitation of disabled men is peculiarly dependent upon their mental attitude. The more serious the disability, the greater the danger of mental depression and an indisposition to respond to medical and surgical treatment. The educational work should begin, therefore, at the moment when the man has arrived at the stage where he begins to worry about his future, whether in this country or overseas. The first problem is to divert his attention by simple recreation, through reading, pictures, games, handiwork occupations, and the like, with a view to securing a genuine interest in the attainment of some worthy end—the end most certain to hold his attention and to claim his best efforts in his future vocation. Hence, by gradual steps he may be induced to supplement his previous vocational experience by academic, scientific or technical instruction, or to choose a new vocation and begin preparation for it if such a course is necessary.

The need of "cheer-up" work in the hospitals extends to all who are mentally capable of planning for their own future. This means a relatively large proportion of the entire number. The beginning is made at the bedside with handicrafts of various kinds grouped under the term "occupational therapy." When the man is able to leave the ward and can be benefited physically by technical training, he has the opportunity of working at specific trades either in the curative workshop, in specially provided classrooms, or out of doors.

The teachers for this work have been secured from the convalescent disabled soldiers who are already skilled in their vocations and from the enlisted personnel of the army secured by transfer or by induction of regis-

trants disqualified for general military service but qualified for special limited service. These instructors work under the direction of educational officers chosen for their professional standing in civil life and commissioned in the Sanitary Corps of the Medical Department. The General Staff has just authorized commissions for 119 educational officers for this purpose.

From the military standpoint disabled soldiers may be placed in three general classes: (*a*) Those who can be restored to full duty. (*b*) Those who can be fitted for limited service. (*c*) Those disabled to the extent of unfitting them for further military service.

It is the announced policy of the Surgeon-General that patients of the first class (*a*) should have, when circumstances warrant it, the benefit of therapeutic treatment through play, work, and study, as may be prescribed by medical officers, in order that their morale may be stiffened, their special skills improved, their future usefulness increased and their recovery hastened.

Patients of the second class (*b*) should have, whenever conditions permit and the medical officers approve, such specific training—physical and vocational—as will in the judgment of the educational officers best fit such patients for limited service of a particular kind. At present patients are being trained in general hospitals for limited service as general and vocational teachers, typists, printers, tailors, cobblers, harness makers, welders, motor mechanicians, painters, machine workers, woodworkers, bookkeepers, statisticians, telegraphers, photographers, telephone operators, cooks, storekeepers, electricians, etc.

The list will be extended with the advice and cooperation of the committee on education and special service of the War Department to meet other needs as they arise. In connection with the large general hospitals there is abundant opportunity for practise in many trades and occupations. At Fort McPherson, for example, practical experience can be gained in twenty different trades. Moreover, there is immediately adjacent to the hospital a large quartermaster's mechanical repair shop, covering all phases of mechanical repair and construction to which men can be assigned for limited service or to gain experience.

Patients of the third class (*c*) should be encouraged in every possible way to accept the benefits accorded them for vocational training by the Federal Board for Vocational Education. To this end they should have while in the hospital such physical training and general education as will best promote their physical reconstruction and at the same time contribute most to their vocational training. Patients who do not elect or who are not eligible to continue their education under the Federal board should receive such training as the medical and educational officers deem best in each individual case.

GEORGE ARCHIBALD CLARK

PROFESSOR GEORGE ARCHIBALD CLARK, academic secretary of Stanford University, died on April 27, 1918, at his home on the campus of the university, after a prolonged illness from a disease that had baffled his physicians. Mr. Clark's illness began more than a year ago with an attack of grip from which he never fully recovered. His legs became so weakened or paralyzed that he was for some time able to walk only with the aid of a cane, and later scarcely at all. He continued to go to his office until last August, and after he was no longer able to do so he continued to look after business matters from his home. His work as academic secretary was hard and exacting and of such a nature that many of the details could not be entrusted to his assistants. This close confinement and constant attention to official duties doubtless had much to do with bringing on the fatal illness.

Mr. Clark was fifty-three years old. He graduated at the University of Minnesota in 1891. In the fall of that year he went to California and registered as a graduate student in Latin at Stanford University which was then just entering upon its first year. Being an expert in shorthand, Mr. Clark was offered a position as stenographer in the university. In 1896 he was made secretary to President Jordan. His unusual ability soon

led to his appointment as secretary of the university, a title a little later changed to that of academic secretary.

Although his office duties were of the most exacting nature, he nevertheless found time to do some teaching. In 1911–12, he offered a course in commercial teachers' training in the department of education, which he later broadened to general secretarial training

In 1896, when David Starr Jordan was made the United States member of the International Fur Seal Commission, Mr. Clark was appointed secretary to the commission. In this capacity Mr. Clark accompanied the commission to the Pribilofs, where he spent many weeks on the seal islands, studying the seals on the rookeries and doing the exacting clerical work of the commission.

He remained as secretary to the commission during the entire period of its existence and visited the seal islands again in 1897 and 1898. During the sittings of the commission in Washington in the winters of those years to Mr. Clark fell the almost herculean task of collating, arranging, classifying and presenting to the commission in proper form for their consideration, the stupendous amount of historical, commercial, political and biological data which the State Department, the Treasury Department, and particularly the commission itself, had assembled. To do this required unusual abilities in a number of lines, including diplomacy, as well as the strength of body and will to work eighteen to twenty hours every day for several weeks. No one but Dr. Jordan, chairman of the commission, and one or two others connected with it, ever knew or realized the invaluable service which George A. Clark rendered our government in those critical days.

The interest in fur-seal matters developed then remained with Mr. Clark to the last. It was he who planned and actually took the first reliable census ever made of the fur-seal herd. So great was his interest in the fur-seal problems and so clearly was his exceptional grasp of those problems realized by the government, that he was again sent to the islands in 1909, 1912 and 1913, by Hon. Charles Nagel, Secretary of Commerce and Labor and George M. Bowers, Commissioner of Fisheries. In each of those years he made a careful census of the fur-seal herd. It was the belief of Mr. Clark and those then in charge of the fur-seal service in the Bureau of Fisheries that a reliable census of the herd for a series of years, together with carefully carried out marking, weighing and other observational studies of the seals, would put the government in possession of knowledge regarding the age of maturity, reproductive period, rate of natural increase, natural mortality, rate of growth, habits of the yearling and two-year-old males and females, and a number of other problems concerning which the lack of definite knowledge has been the cause of most of the disputation regarding fur-seal matters.

So long as killing seals in the open sea was lawful and practised, some of the most important of these questions could not be solved. With the cessation of pelagic sealing, resulting from the convention of July 7, 1911, entered into by the United States, Great Britain, Japan and Russia, it then became possible to make such a scientific study of the fur-seal herd as would give the government the exact knowledge so long and so seriously needed. The government would then be in a position to formulate and put into effect a rational policy for the management of the fur-seal herd.

The season of 1912 was the first in which there was no pelagic sealing. The fur-seal herd was then the smallest in its history. Then was the time to begin its scientific study, according to a carefully thought-out program, to extend over a series of four or five years. It was believed that period would be sufficient to solve the vitally important problems before the herd became so large as to render a census a physical impossibility. This was clearly seen by Mr. Clark and the Bureau of Fisheries, and the census and investigations were promptly begun. They were carried through in the seasons of 1912 and 1913, but unfortunately, changes in method, personnel and scope, since 1913, have made coordination of results difficult if not im-

possible, and the opportunity for the working out of a rational, scientific policy for the management of our fur-seal herd has forever passed.

Mr. Clark threw his whole soul into the fur-seal question which without doubt he understood more clearly than any other man. He contributed numerous articles on this subject to scientific, technical and popular magazines. Several of his articles appeared in SCIENCE and others in THE SCIENTIFIC MONTHLY. He wrote important parts of the four-volume report of the Fur-Seal Commission of 1896 and 1897, and for the Encyclopedia Britannica and the Encyclopedia Americana.

In speaking of Mr. Clark, Dr. Jordan, with whom he was so closely associated for twenty-seven years, said:

George A. Clark was a university official of the very highest type. Exact, patient, courteous, devoted, absolutely unselfish, his services were of the greatest importance to Stanford as a whole and vitally so to the president, who had in the early days, distressing problems of litigation and finance to deal with as well as with the creation of a new university. In every phase of these problems he had the unfailing help of a secretary who never forgot anything; who never gave false color; and whose only thought was the welfare of the institution he served. George Clark was a noble, loyal and capable soul, one to whom I owe personally very much.

BARTON WARREN EVERMANN
MUSEUM,
CALIFORNIA ACADEMY OF SCIENCES

SCIENTIFIC EVENTS

PROPOSED FEDERAL HEALTH PROGRAM

The Municipal Journal states that complaint has been made by Dr. S. S. Goldwater on behalf of the War Service Committee of the American Hospital Association that the Treasury Department, to which President Wilson referred a comprehensive program of health conservation adopted last winter by a group of leading sanitarians, has so far given no indication of formulating such a program. The President referred the program to the Treasury Department on July 1, said Dr. Goldwater. In the executive order of the President all sanitary or public health activities as carried on by any government bureau were given over to the Treasury Department. Since the President has ordered the centralization of the entire health program, says Dr. Goldwater, the time has come to give adequate attention to the other recommendations. The program asked for the appointment of an administrative head known as the Assistant Secretary of Health or perhaps the Health Administrator, to hold his place for the duration of the war. It also asked for the creation in Congress of a Committee on Public Health. Among the important features of health control in wartime which were formulated by the committee were the following:

The establishing of standard procedures for the control of communicable diseases, including reporting diagnoses, treatment and sanitary supervision, and the adoption of these standards by local authorities. Particular attention to be paid to malaria, hookworm disease, typhoid fever, tuberculosis, and the communicable diseases of childhood.

A comprehensive program for the hygiene of war industries to be prepared and put into effect. Among the matters for special attention should be adjustment of the hours of labor to obtain maximum production without damage to the health of the workers. Special attention should be given to the diseases which seriously reduce the efficiency of farm labor in southern states.

Standards for maternity care and for the preservation of the health of infants and children should be prepared and promulgated. A plan should be prepared and put into effect for the registration and after-care of men enlisted or drafted for military service and subsequently rejected or discharged on account of mental or physical defects. This should include, for example, extension of facilities for the sanitarium and home care of tuberculosis victims and for hospital and home treatment for mental defectives and drug addicts.

To insure the quality and make reasonable the cost of essential drugs and biological products, standard methods of manufacture and standards of potency should be developed and enforced. A comprehensive propaganda of health education adapted to various localities and all classes of people should be developed.

Steps should be taken to provide for the national registration of deaths, births, and cases of preventable diseases. A program should be prepared

for maintaining an adequate supply of properly trained sanitarians, physicians and nurses during the war. The means for the extension of existing training facilities should be provided by the government.

The members of the conference which prepared the program were Dr. John F. Anderson, formerly director of the United States Hygienic Laboratory; Dr. Haven Emerson, formerly health commissioner of New York; Dr. W. A. Evans, formerly health commissioner of Chicago; Lee K. Frankel, vice-president of the Metropolitan Life Insurance Company; Dr. A. W. Freeman, of the Ohio state health department; Dr. Goldwater; Porter Lee, of the New York School of Philanthropy; Dr. W. S .Rankin, state health secretary of North Carolina; Dr. E. G. Williams, state health commissioner of Virginia, and Dr. C. E.-A. Winslow, professor of public health at Yale University.

WORK OF THE BUREAU OF FISHERIES

The *Fisheries Service Bulletin* stated that for years the Bureau of Fisheries has been handicapped for lack of facilities for practical demonstrations and experimentation in the methods of preparing and preserving fishery products. The fishery industries, particularly those concerned in canning and otherwise preserving food products, labor under the serious drawback of ignorance of the scientific principles underlying their operations. There is also an underconsumption of fish, arising in part from the inferior quality of much that is placed on the market and in part from ignorance of the consumer regarding the dietetic qualities and peculiarities of the several species, with consequent improper preparation for the table. As a result there is an annual loss of many millions, probably hundreds of millions, of pounds of valuable fish food. With adequate equipment and personnel provided, the bureau has held that it could render effective aid in developing methods for overcoming such difficulties, and that important results would be achieved in some fields within a short period of time.

The President has approved and authorized an allotment of $125,000 from the fund for the national security and defense to enable the bureau to build and equip in Washington a laboratory for the conduct of work of this character and to provide a temporary personnel. Preparations for carrying out this program are being pushed vigorously, and investigations have been started which, it is anticipated, will yield important results in making available larger quantities of fish for food and in educating the public to the merits of the various fishery products.

As large quantities of fish preserved by salting are lost annually by spoilage and still larger quantities of fresh fish, for which there is no immediate market, are thrown away because of the risk of loss if cured, an investigation for the purpose of developing satisfactory methods for overcoming these difficulties has been inaugurated. Donald K. Tressler, well qualified by training and with practical experience as an analytical chemist for a salt-manufacturing company, has been employed for this work. For the present this experimental work will be conducted at Johns Hopkins University, under the supervision of Professor E. V. McCollum.

A trained worker in domestic science has been employed to carry on experiments with new fishes and fishery products to determine the best methods for preparing these products for the table and to begin the assemblage of material for a publication on fish cookery. In addition, quite extensive experiments have been made in the development of methods suited to the canning of fish in the home, and plans have been laid and machinery has been assembled for the conduct of experiments in drying fish in vacuo.

As rapidly as the services of suitably trained persons for a number of other investigations can be obtained such investigations will be taken up. One of these has to do with the increased utilization of fish waste for manufacture into oil and fish meal or fertilizer.

The Bureau's position for work along the lines outlined has been strengthened further by the provision made by the present Congress for an assistant for developing fisheries and for the saving and use of fishery products.

PUBLICATIONS ON EXPERIMENTAL BIOLOGY AND GENERAL PHYSIOLOGY

A SERIES of monographs covering the subjects of experimental biology and general physiology is announced by the J. B. Lippincott Company under the general editorship of Jacques Loeb, T. H. Morgan and W. J. V. Osterhout. The aim and character of the series are indicated by the following announcement of the editors.

The rapidly increasing specialization makes it impossible for one author to cover satisfactorily the whole field of modern biology. This situation, which exists in all the sciences, has induced English authors to issue series of monographs in biochemistry, physiology and physics. A number of American biologists have decided to provide the same opportunity for the study of experimental biology.

Biology, which not long ago was purely descriptive and speculative, has begun to adopt the methods of the exact sciences, recognizing that for permanent progress not only experiments are required but that the experiments should be of a quantitative character. It will be the task of this series of monographs to emphasize and further as much as possible this development of biology.

Experimental biology and general physiology are one and the same science, by method as well as by contents, since both aim at explaining life from the physico-chemical constitution of living matter. The series of monographs on experimental biology will, therefore, include the field of traditional general physiology.

The following is a list of the volumes announced:

Published

Vol. 1. Jacques Loeb (Rockefeller Institute), "Forced Movements, Tropisms and Animal Conduct."

In Preparation

T. H. Morgan (Columbia University), "The Chromosome Theory of Heredity."

E. M. East and D. F. Jones (Bussey Institution, Harvard University), "Inbreeding and Outbreeding: Their Genetic and Sociological Significance."

H. S. Jennings (Johns Hopkins University), "Pure Line Inheritance."

R. Pearl (Johns Hopkins University), "The Experimental Modification of the Process of Inheritance."

E. G. Conklin (Princeton University), "Localization of Morphogenic Substances in the Egg."

R. G. Harrison (Yale University), "Tissue Culture."

W. J. V. Osterhout (Harvard University), "Permeability and Electrical Conductivity of Living Tissue."

L. J. Henderson (Harvard University), "The Equilibrium between Acids and Bases in Organism and Environment."

T. B. Robertson (University of Toronto), "Chemical Basis of Growth."

G. H. Parker (Harvard University), "Primitive Nervous System."

A. R. Moore (Rutgers College), "Coordination in Locomotion."

There is also announced the publication of *The Journal of General Physiology* under the editorship of Dr. Jacques Loeb, the Rockefeller Institute for Medical Research, New York, and Professor W. J. V. Osterhout, Harvard University, Cambridge, Massachusetts. It will be published bimonthly from the Rockefeller Institute for Medical Research, beginning in September. The editors say:

The Journal of General Physiology is intended to serve as an organ of publication for papers devoted to the investigation of life processes from a physico-chemical viewpoint. As the constitution of matter is the main problem of physics and physical chemistry, so the constitution of living matter is the main problem of general physiology, and in both cases the method of quantitative experimentation is required.

Under the pressure of the demands of medicine and of other professions, physiology has developed in the direction of an applied science, with limited opportunity for the investigation of purely theoretical problems. On the other hand, the physico-chemical methods of analyzing life phenomena have thus far made little inroad into the domain of zoology and botany. Under these circumstances, it has happened that what might be regarded as the most fundamental of all the biological sciences, namely general physiology, has not come to have a journal of its own. It is this condition which the establishment of *The Journal of General Physiology* is intended to correct.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM WALLACE CAMPBELL, director of the Lick Observatory, University of Cali-

fornia, has been elected a correspondant de l'Institut de France in the section of astronomy.

SIR JOSEPH LARMOR, M.P. for the University of Cambridge, has been awarded the Poncelet prize for the mathematical sciences this year by the French Academy of Sciences.

THE Paris Academy of Sciences has awarded the Montyon prize, consisting of 2,500 francs, to Drs. Henri Guillemard and André Labat, of the medical faculty of Paris, for their research work on asphyxiating gases.

AT a meeting of July 30, the Paris Academy of Medicine elected, as vice-president for 1918 to succeed the late Professor Pozzi, Dr. Delorme, director of the School of Military Medicine. Conforming to the regulations of the academy, the vice-president succeeds to the presidency the following year.

THE Madrid Academy of Medicine has elected Dr. Max Nordau corresponding member. It will be remembered that he has been in Madrid since early in the war.

DR. HUGH M. SMITH, the commissioner of fisheries, was at Woods Hole in the latter part of July for the purpose of collaborating with Mr. William A. Found, superintendent of fisheries of the Dominion of Canada, in the preparation of the draft of the final report of the International Fisheries Conference.

PROFESSOR A. TANAKADATE, professor of physics in the University of Tokyo, visited Washington in July in the interest of international scientific work.

DR. ELWOOD MEAD, chairman of the Land Settlement Board of the State of California, has been appointed by Secretary Lane to assist in formulating a national policy for colonizing returned soldiers of the American Expeditionary Forces.

DR. EDGAR BUCKINGHAM, of the Bureau of Standards, has been appointed physical associate to the scientific attaché to the American embassy at Rome.

DR. T. GRIFFITH TAYLOR, of the Meteorological Bureau of Australia, has been awarded the David Syme Research prize for 1918 for a thesis based on the correlation of Australian physiography, meteorology and climatology, with special reference to the control of its settlement and industrial development.

DR. FRANK J. MONAGHAN has been appointed deputy health commissioner in charge in Brooklyn to succeed Dr. Frank B. Knause, who has resigned in order to join the Medical Reserve Corps of the United States Army.

DR. CARL E. SEASHORE, professor of psychology in the University of Iowa, is conducting investigations on certain problems of hearing as related to the army and navy, and is also devising and standardizing a series of tests for the selection of telegraphers and radio operators. R. H. Sylvester, assistant professor of psychology, is now lieutenant and chief clinical psychologist at Camp Dodge.

PROFESSOR GUY F. LIPSCOMB, of the Clemson Agricultural College of South Carolina, is engaged for the summer on military work in the Chemical Laboratory at Princeton University.

DR. OLAF ANDERSON, petrologist at the Geophysical Laboratory of the Carnegie Institution at Washington, has resigned in order to accept the position of government geologist and director of an experimental silicate laboratory for the Norwegian Government, in Kristiania.

PROFESSOR E. W. GUDGER spent the present summer at the American Museum of Natural History, collaborating on the "Bibliography of Fishes which the museum is now publishing.

PROFESSOR ROBERT F. GRIGGS, of the Ohio State University, director of the Katima Expeditions of the National Geographic Society, has received a wireless message from this year's field party composed of Messrs. Jasper Sayre and Paul R. Hagelbarger announcing the successful termination of the season's field work in the Valley of Ten Thousand Smokes. The party carried the topographic survey, begun last year, forward to the shore of the Bering Sea, adding some 1,500 square miles to the map and completing a section across the base of the Alaska Peninsula from Katmai Bay to Naknek. This survey will furnish the data for the construction of a topographic map on

the scale of 1/250,000 of the same standard of accuracy as the work of the United States Geological Survey on maps of this scale. In the Valley of Ten Thousand Smokes, beside continuation of the general exploration and securing many valuable photographs, they succeeded in obtaining the first accurate measurement of the temperatures of the vents. For this purpose the expedition was equipped with pyrometers by the geophysical laboratory of the Carnegie Institution. They report the highest temperature measured as 430° C. Although this is subject to correction when the instruments are recalibrated on returning to the states, it probably indicates correctly the order of magnitude of the temperature of the valley. The expedition expects to return home overland *via* the Iliamna route, probably reaching Seattle about September 15.

A Washington Section of the American Institute of Mining Engineers has been organized. The officers elected are Mr. Herbert Hoover, of the Food Administration, chairman; Dr. H. Foster Bain, of the Bureau of Mines, and Dr. David White, of the U. S. Geological Survey, vice-chairmen, and Mr. Harvey Mudd, secretary.

The Committee on Mineral Imports and Exports has finished its work of formulating programs for the minimum importation of ores and minerals, and the members of the committee have taken up other work. Professor C. K. Leith has been appointed mineral adviser to the War Industries board from the standpoint of the conservation of shipping, Mr. J. E. Spurr is in charge of the war minerals investigation work of the Bureau of Mines, and Mr. Pope Yeatman continues in charge of the Non-Ferrous Metals Divisions of the War Industries Board.

We learn from *Nature* that the Electrical Research Committee, which was appointed last autumn, under the auspices of the Department of Scientific and Industrial Research, is at present engaged in superintending a research on insulating materials (fibrous materials, porcelain, ebonite, mica, composite materials) and the water-proofing treatment of insulating windings of electrical machines, in respect of which grants have been made to the Committee by the Research Department, the British Electrical and Allied Manufacturers' Association, and the Institution of Electrical Engineers. The Committee consists of three members nominated by the institution, and three members nominated by the B.E.A.M.A., the nominees of the former being Mr. C. H. Wordingham (chairman of the Committee), Mr. C. C. Paterson, and Mr. C. P. Sparks, and those of the latter Mr. F. R. Davenport, Mr. D. N. Dunlop, and Mr. A. R. Everest.

The *Journal* of the American Medical Association states that the members of the National Public Health Service of Brazil have erected a monument to Oswaldo Cruz on the grounds of the Public Health Building at Rio de Janeiro. The bronze portrait figure is seated in the professorial chair, with arms resting on a desk, in a peculiarly graceful and easy pose. The inscription reads: "A Oswaldo Cruz, Homenagem do pessoal da Directoria Geral de Saude Publica, 23-III-1903—19-VIII-1909," the dates marking the period of his most productive work, the eradication of yellow fever from Rio. The statue was unveiled with much ceremony recently in the presence of the highest officials of the country. The *Brazil Medico* of June 15 gives an illustration of the memorial.

Harry Kirke Wolfe, professor of philosophy in the University of Nebraska, the author of valuable contributions to experimental psychology, died on July 30, at the age of fifty-nine years.

Adolph von Faber Du Faur, known for his work in mining engineering, died at his home, on August 18 at the age of ninety-two years.

The death is announced of Dr. J. Kollmann, professor of anatomy in the University of Basel.

The death is announced of G. Verriest, formerly professor of internal pathology at the University of Louvain, president of the Belgian Académie de médecine and of the International congress of Neurology at Brussels in 1903.

The thirty-sixth stated meeting of the American Ornithologists' Union will be held at the American Museum of Natural History, New York City, November 12–14, 1918, with a business session of the fellows and members on the evening of the eleventh.

The new National Museum has been closed to the public by the board of regents, as all available space in the building has been occupied by the Bureau of War Risk Insurance. It is expected that the museum will be again opened when the new office building of the bureau, at Vermont Avenue and H Street, is completed.

It is stated in the *American Journal of Science* that the Swiss Chemical Society, founded some seventeen years ago, has recently issued the first part (pp. 1–96) of a new periodical, to be devoted to pure chemistry and to serve as the organ of the society. The editorial committee consists of MM. Bosshard, Fichter, Guye, Pictet, Rupe and Werner, all of Switzerland. The present plan is to issue 6 to 8 parts yearly, aggregating from 500 to 1,000 pages; the subscription price is 25 francs per year.

At the last national medical congress in Mexico, it was voted to found a medical journal in which to publish the work of Mexican physicians and surgeons and to keep them informed of the progress of the medical sciences in other lands. The executive committee, preparing for the approaching medical congress, the sixth, has ratified this decision, and Dr. Francisco Bello, of Puebla, has been appointed editor.

Nature states that following upon the establishment of the Kaiser Wilhelm Institute for Research on Iron and Iron-ores comes the news from the German daily press of some preliminary steps that have been taken to found a similar institution for researches on all other generally useful metals. A committee composed of eminent engineers and university professors has been formed to consider the establishment of a metal research institute for the benefit of the German metallurgical industry.

The series of congresses to be held at Monaco to promote the expansion of the thermal, mineral and climatic stations and baths of the allied and friendly nations will deal with hydrology, hygiene, alpinism, thalassotherapy and watering places. In connection with the congresses there will be an exhibition. The whole is under the patronage of the Prince of Monaco. Professor Maragliano, Senator of Italy, has been elected general president.

The President has authorized a loan of one million dollars to the Forest Service for fire-fighting expenses, to meet the serious emergency conditions in the national forests of the northwest and the Pacific coast states. The loan was made from the special defense fund of fifty million dollars placed at the disposal of the President by Congress. It is recognized that the protection of the national forests is an important and essential war activity. Forestry officials regard the present fire season in the northwest as in some ways the most serious with which the government has ever had to cope. Early drouth, high winds, electrical storms, labor shortage and depletion of the regular protective force as a result of the war have combined to make the fire conditions unprecedently bad. Necessity for resort to the Presidential fund is due to the fact that the appropriation bill for the Department of Agriculture for the current year has not yet been passed.

The council of the British Institution of Electrical Engineers is prepared to receive papers, not exceeding 15,000 to 20,000 words in length, on the subject of the "Coordination of Research in Works and Laboratories," and to award a special premium of £25 to the author of the paper which in their judgment best fulfils the object of the discussion. The papers should be sent to the secretary of the institution not later than November 4 next, and it is intended that the one selected shall be read and discussed at one of the ordinary meetings of the institution and shall afterwards be published in the *Journal*.

Nature reports that the following grants of money for research committees were voted by the General Committee of the British Associa-

tion at the meeting in London on July 5: —*Section A.—Mathematical and Physical Science:* Seismological investigations, £100; discussion of geophysical subjects, £10. *B.—Chemistry:* Colloid chemistry and its industrial applications, £5; non-aromatic diazonium salts, £7 7s. 8d. *D.—Zoology:* Inheritance in silkworms, £17. *F.—Economic Science and Statistics:* Women in industry, £10; effects of the war on credit, etc., £10. *H.—Anthropology:* Paleolithic site in Jersey, £5; archeological investigations in Malta, £10; distribution of bronze-age implements, £1; age of stone circles, £15; anthropological photographs, £1. *I.—Physiology:* The ductless glands, £9. *K.—Botany:* Heredity, £15; Australian Cycadaceæ, £17s.; Australian fossil plants, £15. *L.—Educational Science:* The "free-place" system, £5.

UNIVERSITY AND EDUCATIONAL NEWS

It is officially announced that Yale University will receive, as residuary legatee of the late John W. Sterling, about fifteen million dollars, which will nearly double the endowment of the university.

A special three months' course at the New York University and Bellevue Hospital Medical College has been arranged for those who wish to qualify as laboratory assistants in bacteriological work for immediate service in the camps and hospitals. The course is arranged by Dr. William H. Park, director of the laboratories of the New York Health Department, and Dr. Anna M. Williams, assistant director. It will open September 4.

The College of Physicians and Surgeons of San Francisco has discontinued the teaching of medicine, but will retain a nominal existence for the next three years so as to grant diplomas to such students as shall complete their work satisfactorily in other medical schools.

Professor M. E. Graber, fellow in mathematical physics at the University of Chicago, has been elected to the professorship of mathematics in Heidelberg University, Tiffin, Ohio.

Dr. E. V. Cowdry has accepted an appointment in the Peking Union Medical College, China.

Dr. J. C. Whitten, for twenty-four years professor of horticulture and head of the department of horticulture of the University of Missouri, has been appointed chief of the division of pomology of the University of California. Dr. Whitten arrived in Berkeley the middle of August and will begin his work on September 1.

Mr. R. Douglas Laurie, who has been chief demonstrator and assistant lecturer in zoology and lecturer in embryology in the University of Liverpool for some years, has been appointed head of the department of zoology in the University College of Wales, Aberystwyth.

DISCUSSION AND CORRESPONDENCE

HAND-MADE LANTERN SLIDES

As well expressed by Dr. Gray in Science, July 12, 1918, p. 43, it is of advantage and often of the greatest convenience to be able to prepare quickly for projection a series of lantern slides showing diagrams, tabulated data, etc. Dr. Gray suggests the use of celluloid instead of gelatin sheets for this. Both the gelatin and the celluloid sheets must be supported by glass plates to hold them flat. Celluloid and gelatin receive the pen wall, and are far less expensive than regular photographic lantern slides.

It was found by the present writer that for all the purposes of simple diagrams, tables, etc., a still simpler method answers admirably. Advantage was taken of the device employed by the lantern-slide artists who made by hand all the lantern slides before photographic ones were invented (1850). The device consists of varnishing the well-cleaned glass with a very thin solution of some hard varnish. When the varnish is dry the pen or brush can be used upon the varnished surface with the same ease as upon good paper. India ink gives the sharpest images and a fine pen is to be used for the writing or drawing.

In preparing the slides the glass is held by the edges between the thumb and fingers

and the varnish poured on until the surface is covered, then the excess is drained off one corner and the glass is placed in a negative rack to dry. For a varnish, any good, transparent varnish may be used. It should be diluted to about one tenth the usual thickness. For the diluting substance xylene, toluene, turpentine, etc., may be used. Varnish diluted with xylene will dry on the glass in about half an hour if the room is dry and warm. If turpentine is the diluent it is better to let the varnish dry over night.

If the slide is to be used for a single exhibition it need not be covered and bound, but if it is to be permanent it is better to protect the surface by covering and binding as with photographic lantern slides.

If the slides are coated with 10 per cent. gelatin and dried one can also use the pen and brush well, but the varnish has proved a better coating.

These varnished glasses for hand-made lantern slides have been in use in different departments of Cornell University for the last six years and have proved very satisfactory.

It may be well to call attention to the fact that nearly all forms of celluloid are inflammable, and slides made of it might bring disaster.

Simon H. Gage

Cornell University,
July 30, 1918

THE HOUSE FLY

To the Editor of Science: The accompanying paper was written by one of my students in elementary biology within one month of the opening of the course. It happened that the house fly was providing the material for laboratory work at that time. And it also happened that several students were attracted by the inconclusive statements in several textboks regarding the function of the so-called *balancers*—which they had already recognized as probably representing the second pair of wings. Experiments were thereupon encouraged to clear up the situation. At first results were conflicting, owing to excusable defects in operative technic. Mr. Whealdon, however, succeeded in reaching unequivocal results, which he embodied in the report that is printed below just as he wrote it.

My purpose in bringing this report to your attention is primarily pedagogical. The facts established by Mr. Wealdon can not lay claim to novelty, as he later discovered. But the method of permitting a student in an elementary course at the very beginning of his work to occupy himself in laboratory hours with a problem he himself had raised and frankly to regard such work as a research—which indeed it is in every essential—to be carried to a real conclusion, quite regardless of the activities of the other students in the laboratory; this method, which subordinates prearranged plans by the instructor to the encouragement of student initiative, may be still sufficiently uncommon in American schools and colleges to justify submitting the accompanying evidence of its efficiency.

Harry Beal Torrey

THE BALANCERS OF THE HOUSE FLY

Report of Some Experiments to Determine their Use

Experiment 1.—I put two flies of apparently equal vigor, but differing slightly in size and coloring of the abdomen, under the influence of ether. From one of them I removed the balancers by means of very sharp pointed scissors. The other I left untouched, using him merely as a check, by which I could compare the actions of the two as they came out from the influence of the anesthetic. This process I repeated with two more flies, then placed them in pairs, one clipped fly with one unclipped, under bell jars, and observed their behavior.

Through the difference in size and marking I was able to identify the unclipped flies and noted that they appear to recover from the influence of the anesthetic sooner than the clipped flies in both cases. As soon as the flies with the balancers removed recovered from the effects of the ether they commenced to rub themselves with their hind legs, stroking their abdomen and wings almost continuously, even lifting their legs quite above the wings and

pressing them down to the table with a stroking movement. The unclipped flies did not do this, and since they appeared entirely normal I allowed them to escape.

The clipped flies continued stroking their bodies and would not attempt flight except when provoked by being touched with a piece of paper which I pushed under the jar. Then their flight was extremely erratic. They seemed to have largely, if not wholly, lost their power of equilibrium. They would fall upside down, and could pursue no direct flight at all.

As a further test I left them under the jar until the following day and repeated observations with the same results. I again put some normal flies in a jar besides the clipped ones to compare action in flight. The unclipped flies had no difficulty in maintaining an upright position while flying about the jar even though they were striking the sides continuously. The unclipped flies stayed in flight much more, and without provocation.

As a final test I took the clipped flies out of the jars and let them go. Although the movements of the wings appeared entirely normal they could not fly, but fell to the floor with an erratic zigzag movement.

Experiment 2.—The procedure in this case was the same as in the first experiment, except that I used five flies instead of two. For each fly that I clipped I imprisoned another, unclipped, that had been subjected to ether for the same period, to use, as in the first experiment, for comparative study. The five from which I removed the balancers I put under one jar. The other five I placed in a second jar beside the first.

These flies I allowed to remain under the jars overnight in order to recover completely from the effects of the ether. On the following morning I found that one of the flies that had been clipped had died; two of the unclipped had succumbed. Probably the dose of ether had been too great.

Upon testing their powers of flight I found that the clipped flies, just as in the first experiment, were altogether unable to maintain equilibrium. Not one of them when released could fly at all, but dropped to the floor with a zigzag darting movement. The unclipped flies flew off in normal flight.

Experiment 3.—Having acquired considerable skill at removing the balancers I put a large number of flies under the anesthetic at once. Then from nine flies I removed both balancers and placed them all under one jar. From eight flies I removed *one* balancer and put them under a second jar; and finally I put seven flies under a third jar. These seven had been subjected to the same dose of ether, but I left them untouched and confined them for comparative study as in the other experiments.

The results accorded exactly with those of the other tests.

(*a*) Flies seemed to notice the removal of the balancers, and kept stroking themselves with their legs about the wings and abdomen.

(*b*) In no case was a fly with both balancers removed able to fly. They could use their wings, but had no power of equilibrium.

But in contrast to this, the flies with only one balancer removed could fly without difficulty, in a manner to all appearances perfectly normal, although sometimes I thought they had slight difficulty in gaining balance at the commencement of a flight.

From these experiments I concluded that the balancers of the fly are intimately connected with his nervous system, and by a distinct and essential function enable him to maintain equilibrium in flight. But just as a man is not deaf who has one ear injured, nor blind though one eye is destroyed, so this power of equilibrium is not essentially impaired without the removal of *both* balancers.

Submitted November 8, 1917.

Rowan Whealdon

QUOTATIONS

THE PROPOSED BRITISH MINISTRY OF HEALTH

The Ministry of Health Bill, which has been under the consideration of Sir George Cave's Home Cabinet, will not, we imagine, prove to be a measure as comprehensive and revolutionary as recent debates and discussions might lead the public to suppose. In this connection

we may recall the suggestion put forward last January[1] by a group of ten members of Parliament headed by Major Waldorf Astor, now Parliamentary Secretary, Ministry of Food. The group advocated the combination and reorganization of existing departments for the setting up of a Ministry of Health, and submitted the heads of a bill providing that so soon as the new ministry had been established by Parliament all the powers of the Insurance Commissions for England and Wales, and all the powers of the Local Government Board, should be transferred to it by order in council, that the health functions of other departments should be taken over at such times as were found convenient, and that there should be power to transfer from the new ministry to other departments any functions transferred to it at first for the sake of convenience but found to be unsuitable for a health ministry to perform. Under this scheme the new ministry would be simultaneously acquiring and shedding powers, and although the method was recognized to be clumsy, the promoters believed that by this expedient matters of national health would be discussed on their merits undisturbed by conflicting claims of rival authorities. Writing on the subject some four months ago, we said that the indications then were in favor of the government bill being a measure to amalgamate the Insurance Commissions in England and Wales with the Local Government Board, leaving the non-medical functions of the latter department to be shed at a later date. There is general anticipation that the medical functions of the Board of Education would also be handed over, but with this possible addition the present position appears to be the same to-day as it was in March. If the bill is introduced in this form, it will undoubtedly come in for much criticism. If it means that the Ministry of Health, to quote Sir Bertrand Dawson's words, is not to have "a bigger horizon than the Local Government Board and Insurance Commission, then we must emphatically say 'No.'" On principles, as he said, there can be no compromise—"the practise of putting the skilled under the control of the unskilled must cease." One plan for preventing the perpetuation of this evil in the new ministry is outlined in the scheme of the British Medical Association, which proposes the establishment of an Advisory Council of experts. This council should hold regular meetings not less often than once a month, should have direct access to the minister, and should have the power of initiation—that is to say, it should have the right and obligation to tender its advice to the minister on any subject which it considered ought to be dealt with, and not merely on such matters as the minister referred to it. It is proposed to meet the objection that the Board's advice could always be overruled by the minister, acting perhaps under the influence of permanent officials—not experts either in medicine or any of the other professions concerned in the prevention of disease or the maintenance of health—by requiring reports of the Advisory Council to be presented to Parliament. What value this expedient would prove to have in practise is a matter upon which there is room for difference of opinion; but, provided the Minister had efficient permanent medical officials in an independent position of direct responsibility to him, it would undoubtedly afford some safeguard against the risk of "putting the skilled under the control of the unskilled."—*British Medical Journal.*

[1] *British Medical Journal*, January 19, 1918, p. 98.

SCIENTIFIC BOOKS

The Ornamental Trees of Hawaii. By JOSEPH F. ROCK. Honolulu, published by the author. 1917. Pp. v + 210. Illustrated with 79 plates from photographs and 2 colored plates from paintings. $3.50.

One of the charms of tropical cities is the profusion of flowering shrubs and trees. The reviewer has had the pleasure of spending several months in the Hawaiian Islands and can say that Honolulu is the most attractive tropical city he has ever visited. Much of this attraction is due to the wonderful variety and beauty of the cultivated shrubs and trees of the streets, gardens and parks.

Professor Rock has given us descriptions of the ornamental trees and also of many of the larger and more showy shrubs. The trees are arranged in natural sequence beginning with cycads and pines, and ending with *Ixora* (Rubiaceæ).

Probably the most striking street trees in midsummer are two species of *Cassia*, *C. fistula*, the golden shower, and *C. nodosa*, the pink shower. The golden shower (plate 43) has long racemes of golden yellow flowers followed by cylindric woody pods, 20 to 30 inches in length, straight and smooth like a musician's baton. The pink shower (plate 44) has dense racemes of pink and white flowers, a gorgeous sight when in full bloom in June. There is a colored plate of this in Mr. Rock's book.

Another showy tree is the flame tree, *Delonix regia* (*Poinciana regia*) (plate 45). This is frequently planted in south Florida, where it is called royal poinciana. The large bright scarlet flowers are in large terminal racemes.

The visitor to the Hawaiian Islands is at once impressed with the number and beauty of the varieties and hybrids of *Hibiscus rosa-sinensis* (page 137). In this country the species is sometimes called rose of China. In Honolulu the hibiscus is commonly used as a hedge plant, the large red or white flowers being conspicuous throughout the summer.

Another common hedge plant is a species of the Aralia family (*Nothopanax guilfoylei*) (page 168). This does not flower in Honolulu, but the white-bordered compound leaves are attractive. The crotons (*Codiæum variegatum*) (page 128) are common in Honolulu as they are in all warm countries. The narrow leaves are variegated with white and red, in some varieties strongly spirally twisted.

The pepper tree (*Schinus molle*) (page 132), with feathery drooping foliage and racemes of small red berries, is extensively planted. The plumeria or graveyard flower (*Plumiera acutifolia*) (page 175), with thick stubby branches, milky juice and white or yellow fragrant flowers, is commonly planted around cemeteries. The flowers are much used for the familiar Hawaiian leis or wreaths made by stringing the corollas on a thread.

One of the most beautifully shaped trees of the parks is the rain-tree or monkey-pod (*Samanea saman*) (plate 33). The crown is slightly convex and very wide spread. Another member of the Leguminosæ is the now thoroughly naturalized algaroba (*Prosopis juliflora*) (plate 36). This tropical American tree is now common in a belt along the shore of all the islands. The pods furnish an excellent feed for stock and the flowers furnish honey. It is often planted along streets.

Professor Rock has devoted considerable space to the palms, of which many species are cultivated in the parks and gardens throughout the islands. To this group 23 plates are devoted. The commonest and probably the most beautiful of the palms is the royal palm (*Oreodoxa regia*) (plate 19), the smooth white trunk being very attractive especially when the plants are growing along driveways. The date palm (*Phœnix dactylifera*) (plate 3) is frequent, and the oil palm (*Elæis guineensis*) (plate 22) is not uncommon. The fish-tail palm (*Caryota urens*) (plate 16) is conspicuous because of the great drooping masses of flowers and fruit; the betel palm, because of the tall and very slender stem. Our California fan palm (*Washingtonia filifera*) (plate 10) is rather frequent.

The visitor to the Hawaiian Islands will find the book very helpful in identifying the cultivated trees. The plates are from excellent photographs and the descriptions give just that information that one wishes to know.

A. S. Hitchcock
U. S. Department of Agriculture

SPECIAL ARTICLES

A COMPARISON OF THE RESPONSES OF ANIMALS IN GRADIENTS OF ENVIRONMENTAL FACTORS WITH PARTICULAR REFERENCE TO THE METHOD OF REACTION OF REPRESENTATIVES OF THE VARIOUS GROUPS FROM PROTOZOA TO MAMMALS[1]

The behavior of animals in gradients of intensity of stimuli has long been studied.

[1] Contribution from the Zoological Laboratory, University of Illinois, No. 120.

Gradients of temperature, light, moisture, etc., were established by the earlier experimenters with a view to determine the conditions which the animals "preferred." Others tested the reactions of animals in gradients of food and other chemicals in connection with investigation of senses and sense organs The earlier work was very general, but later the study of the reactions of protozoa in accurately determined temperature gradients[2] was undertaken. In the study of reactions to light, Yerkes[3] first used the cylindrical lens and established definite and accurate light gradients. Mast[4] developed methods of measuring light.

In 1911[5] the writer and Dr. Allee devised a gradient tank in which a definite permanent gradient of substances dissolved in water can be obtained. This was later improved and some of the sources of irregularity eliminated. A figure of the improved tank is shown by Wells.[6] He tested the gradient fully with a conductivity cell and established the general character of the gradient for salts.[7] The writer[8] also devised a gradient cage for air work, air of different character being driven across the respective thirds of a cage so as to give three kinds of air with a slight mixing at the meeting points.

In connection with the study of fishes the writer devised a method of graphing the movements of animals in gradients. This is illustrated on the accompanying chart, graph 1. Here the distance from right to left represents the length of the gradient tank or the distance at right angles to the iso-lines such as isotherms, that might be drawn across it. In making the graphs, movements along the isolines are ignored and only movements which change the position of the animal in the stimulus are represented. Thus in graph 1 the distance from right to left represents the length of the cage. The scales at the sides represent time in minutes, each of the larger units being two minutes. The movements of the animal are drawn to the time and cage length scale. The animal shown in graph 1 (a white-footed wood mouse) remained in the still air (left third) 45 seconds, spent fifteen seconds going the middle of the high velocity third (right third), turned back and returned twice, and was headed toward the still air end at the end of one minute and thirty seconds after the beginning, etc. These graphs can not be made with mechanical exactitude but a high degree of accuracy can be attained. With a watch adjacent to the cage and a little practise there is no difficulty in making such records.

The gradient as encountered by the animal is usually a uniform increase or decrease in the intensity of stimulation except in the air work where there are three steps with two steep gradients between them. In all the experiments cited here one end of the container is near to the optimum for the species. In experiments where the optimum is near the center animals turn back from both ends. There is nothing to cause the animals to move. They do so spontaneously or because of the unusual surroundings. In the narrow tank they must go lengthwise; in so doing they encounter the stimulus. No marked adaptation appears to take place. Goldfish were observed to behave in the manner described below for six hours. Controls in which the animal encounters no change in going the length of the tank are not shown here. In the work cited controls accompany all experiments and have been considered in the case of all work here discussed. A number of psychological points arising in this connection such as learning, Weber's[9] law, etc. are discussed in the papers cited. The purpose of this account is to compare animals of different groups.

In watching the behavior of mammals, reptiles, amphibians, fishes, insects, myriopods, annelids, flatworms and protozoa in gradients of temperature, light, moisture, air velocity,

2 Davenport, *Expt. Morphology*, Vol. I., pp. 260–262.

3 Yerkes, Mark Anniversary Volume, p. 361.

4 Mast, "Light and the Behavior of Organisms," Philadelphia.

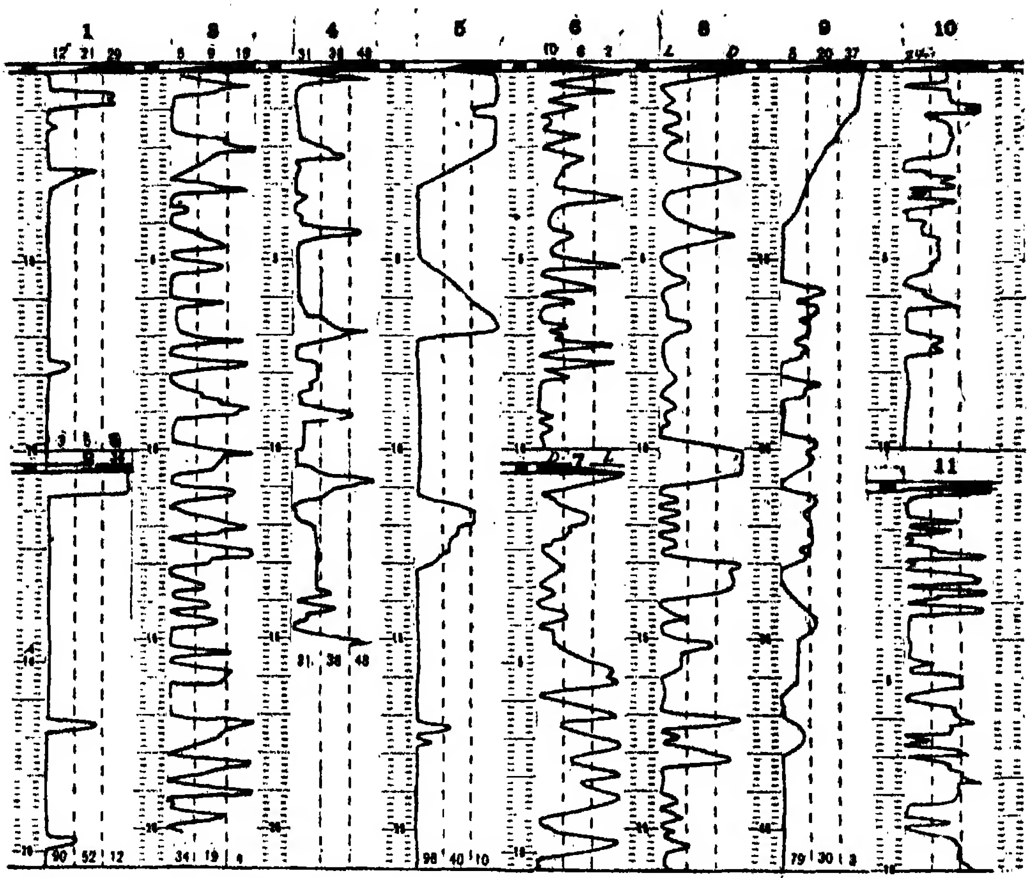
5 Shelford & Allee, *Jour. Expt. Zool.*, Vol. XIV., p. 226.

6 Wells, *Biol. Bull.*, Vol. XXIX., p. 223.

7 Wells, *Jour. Exp. Zool.*, Vol. XIX., p. 246.

8 Shelford, *Biol. Bull.*, Vol. XXV., p. 81.

9 Powers, *Biol. Bull.*, Vol. XXVI., pp. 177–200.



Description of Chart. For further details see citations in text.

Graph 1. A white-footed wood mouse (*Peromyscus leucopus noveboracensis* Fischer) in an evaporation gradient due to differences in air velocity. The figures at the beginning of the graph indicate the evaporation for the experimental period in tenths cubic centimeters of water; those at the end indicate air velocity in meters per second. (After Chenoweth.)

Graph 2. A white-footed wood mouse in an air humidity gradient. The figures at the beginning of the graph indicate evaporation and at the end relative humidity in per cent. of saturation. (After Chenoweth.)

Graph 3. A horned lizard (*Phrynosoma modestum* Gir.) in air humidity gradient; figures as in 2. (After Weese.)

Graph 4. A horned lizard in a substratum temperature gradient; the figures indicate temperature in degrees centigrade. (From Weese, unpublished.)

Graph 5. A common toad (*Bufo lentiginosus* Shaw) in an air humidity gradient. Figures as in 2 and 3.

Graph 6. A small sunfish (*Lepomis humilis* Gir.) in an ammonia gradient in alkaline water. Maximum concentration of ammonia at left, 7–10 pt. per million.

Graph 7. A ground beetle (*Platynus cupripennis* Say) in a light intensity gradient.

Graph 8. The same individual ground beetle in an oblique sage intensity-direction gradient.

Graph 9. An earthworm (*Helodrilus caliginosus*) in an air moisture gradient. Figures as in 2, 3 and 5. (From Heimburger, unpublished.)

Graph 10. A single *Paramœcium* in a temperature gradient in which the cool end was near the optimum.

Graph 11. A single *Paramœcium* in a temperature gradient which resulted in death at the end of 12 minutes.

dissolved chemicals, lack of oxygen, etc., and in examining several hundred graphs made of their movements one is impressed with certain almost universal features of the reactions. In nearly all cases the animal becomes more sensitive to the stimulus after encountering its maximum intensity in the tank. It turns back from a weaker stimulus after encountering a stronger one; the threshold of stimulation is lowered. In the case of some animals the increased irritability persists for an hour or more while in others it lasts only a few minutes. In the latter case a few turnings in the lower intensity or a brief stay in the lower intensity permits a return to the original sensibility and the animal enters the highest intensity again, a rhythm of increased and decreased irritability thus occurs.

The graphs shown on the accompanying chart are selected to illustrate several stimuli and the reactions of several animal groups. Graph 1[10] shows the reaction of a white-footed wood mouse in a gradient of air velocity producing evaporation as shown at the head of the graph in tenths cubic centimeters. It will be noted that after entering the high velocity air at the right once the subsequent movements in that direction were each shorter than the preceding. Graph 2[10] shows the reaction of a mouse to air of different humidities. The method of reaction is similar to that to moving air. The relative humidity in the thirds is shown at the end of the graph and the evaporation at the beginning.

Graph 3[11] shows the reaction of a horned lizard to air of high evaporating power, the humidity being shown at the bottom and the evaporation in tenths cubic centimeters at the beginning. The invasions of the dry air during the first three minutes were followed by invasion only into the medium air. These are followed by six invasions of the dry air but with very short stays. Following this, from the thirteenth to sixteenth minute, the invasions reached only just through the medium air. The rest of the graph shows similar modifications and illustrates the rhythmic raising and lowering of the threshold of stimulation. Graph 4 (from Weese—unpublished) shows the reaction of a horned lizard in a temperature of substratum gradient; the temperature in centigrade at the ends and center is shown by the figures at the beginning of the graph. Each excursion in to the higher temperature is followed by shorter invasions reaching only to medium temperatures.

Graph 5 shows the reaction of a common toad in a gradient of air moisture and evaporation, the evaporation is given at the beginning of the graph and the humidity at the end. In this case each invasion of the dry air is shorter than the preceding ones. Graph 6 shows the reaction of a sun fish (*Lepomis humilis*) in a gradient of ammonia in alkaline water. The fish was positive to the ammonia, and made excursions only into the low concentration of ammonia, following each invasion into the water nearly free from ammonia.

Graph 7 shows first graph of the reaction of a ground beetle taken at random, in light intensity gradient (Yerkes grader with Nernst lamp; triangular aperture). During the first five minutes the beetle avoided the stronger light in a lower intensity with each invasion, until it reversed and repeated the same rapid modification in invading the darker portions. After a five minute interval following the end of the first observation, the animal was transferred to a grader in a horizontal position with an oblique cage, cylindical lens,[12] and triangular aperture. The oblique cage was turned so that in moving away from the source of light the animal came rapidly into lower intensities. Graph 8 shows the reaction of the same beetle in this gradient. Each invasion of the darkest part of the cage is followed by turning back a number of times in a comparatively high light intensity. The rhythmic change in sensibility is well illustrated here also.

Graph 9 (from Heimburger) shows the reaction of an earthworm (*Helodrilus caliginosus*) in a gradient of air moisture The first twenty minutes which were spent in the dry

10 Chenoweth, *Biol. Bull.*, Vol. XXXII., p. 192.

11 Weese, *Biol. Bull.*, Vol. XXXVII., p. 115.

12 Shelford, *Biol. Bull.*, Vol. XXVI., p. 309.

air where the worm was placed, are not shown. After entering the moist air the worm turned back in progressively higher moisture contents, until the end of fifteen minutes of the scale; another somewhat longer invasion is followed by the same repeated decrease in invasion between 16 and 26 minutes and between 29 and 36 minutes.

A series of preliminary experiments were performed on *Paramœcium*. After a number of trials in which chambers of different sizes were used, a chamber was cut out of a large drop of beeswax darkened with graphite, on a slide. This chamber was 2 mm. wide, 9 mm. long, and 1 mm. deep. The slide was laid over the edges of two Petri dishes. Water at 36° C. was run into one of these and water at 16° C. into the other. The optimum of the culture was 23° C. as shown by the point of aggregation of the greatest number of individuals in a box 5 mm. deep, 20 mm. wide, and 170 mm. long. The apparatus at hand did not permit measurements of temperature in the 2 mm. x 9 mm. chamber. The position of the slide over the hot and cold water was so adjusted with a considerable number of individuals in the cell, that they aggregated at the cold end rather than at any point in the long axis of the cell. Movements were observed with a binocular. A single individual was then introduced from a diluted infusion.

It is not possible for one person to observe and graph the movements. The writer accordingly observed the animals and stated their position according to a scale, etc., while another person with watch at hand drew the graphs. Graph 10 is typical of what was observed repeatedly. Several invasions of the high temperature occurred before the graph began. This is due to the fact that when water was removed from the cell and another drop added it was necessary to allow two or three minutes for the drop to attain the temperature which accorded with the temperature of the slide beneath it. After the graphing began, an invasion of the high temperature at the end of the first minute was followed by turning in lower temperature. An invasion which did not reach the highest temperature at the end of the third minute was followed by two turnings in much lower temperature. An inspection of the rest of the graph shows that each invasion of the high temperature is followed by two or three turnings in lower temperature; this was the rule in the ungraphed observations.

Graph 11 shows the reaction of an individual, beginning within five to ten seconds after the drop was introduced into the chamber. No time was allowed for the temperature of the drop of water to become adjusted. Accordingly the temperature at the warm end rose while the observations were going on. The slide has also been shifted too far over the hot water. When the graph began the animal was in the hot end; it moved to the cool end and on its return, turned back twice in lower temperatures. Then one long invasion of high temperature was followed by a very short one; three long ones, by a period of rest. During this period avoiding reactions had increased in violence until they began to dominate over other movements and the temperature had risen to a point where normal reaction did not occur. The animal darted rapidly, giving the avoiding reaction in the higher temperatures, so violently that none of the courses were followed up and after a number of rather long stays in the high temperature it died. One striking feature of the behavior is the orientation of the individuals in the long axis of the gradient. This is however apparently trial and error and, as Jennings has noted, when headed toward the optimum temperature they swim ahead without giving the avoiding reaction. The graphs bring out the fact that they give the avoiding reaction at different temperatures in accord with their preceding experience. It is however evidently not correct to assume that the *Paramœcium* distinguishes the difference between the temperature of the water in contact with the two ends of the body as shown by dividing the total distance necessary to give a degree difference by the length of the animal. On this basis Mendelssohn[13] decided that they can distinguish one one hundredth of a degree centigrade.

[13] Davenport, *loc. cit.*

They appear from these observations to distinguish the difference between the temperature of the water where they assume the normal forward course and the point where they give the avoiding reaction. This difference within the range of temperatures compatible with the life of the animal is probably some tenths of a degree, varying with the immediate antecedent experience of the individual.

The method of graphing has been found very useful in making accurate determinations of reaction where modification by environment has been attempted and where accurate determination of sensibility is necessary. One has only to take readings from a graph like number 3, make statistical records, and compute percentages in the thirds, repeating the readings, at ½ min., 1-min. and 2-min., intervals, beginning after ½, 1, 2 minutes, etc., after the graph began to demonstrate that percentage in the thirds, with short intervals at least, is a very unreliable method of making records, unless the reading is done with absolute precision.

The occurrence of the rapid modification of behavior described in practically all the great groups of the animal kingdom leads one to attempt to explain the phenomenon on the basis of some physiological characteristic common to all. In connection with the study of fishes the writer and Allen[14] suggested that in both the case of carbondioxide and lack of oxygen in water the increased irritability is due to increased acidity. In support of this we cited Waller who found that a small amount of carbondioxide increases irritability of nerves.

A similar explanation of the shorter invasions of light in a light gradient in which the Daphnias turn back in a lower intensity as described by Davenport and Cannon, was offered by Loeb[15] who anticipated our conclusion, independently derived, and cited Waller though he attributed the development of acidity to the increased metabolism of the organism due to the stimulation.

Since the phenomenon of modification under consideration takes place in gradients of ammonia in alkaline water, and the fishes concerned are positive to the ammonia, and since such behavior has been noted in the avoidance of cold, darkness, etc., which depress metabolism, thus the hypothesis of increased irritability due to acidity can be maintained only on the assumption that all changes in the environment stimulate the metabolism temporarily. This is not out of accord with the effects of depressing drugs which nearly all stimulate first, for a short time, and then depress.

Whatever may be the correct physiological explanation of the phenomenon, we have noted that the process is similar in the mammal and in the Protozoan. The reactions of both are such as to suggest learning, that is, the possible association of increasing stimulation with stronger stimulation farther on in the course being pursued, though it is hardly to be expected in the Protozoan. If the most intelligent animal behaves like the simplest Protozoan and if pleasure and pain are the basis for intelligence, an analysis of this type of modification may yield data showing that the modification is not essentially different from associative memory. The graphs appear to be but a general statement of the gagging of the chick at the sight of a distasteful species of caterpillar which it has tried on an earlier occasion.

V. E. Shelford

University of Illinois

14 Shelford and Allee, *Jour. An. Beh.*, Vol. IV., p. 7. Shelford, *Jour. An. Beh.*, Vol. IV., p. 31.

15 Loeb, "Mechanistic Conception of Life," p. 232.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

Friday, September 6, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

RICHARD RATHBUN

American science has lost one of its distinguished authorities on invertebrate zoology, and the United States National Museum its honored chief by the death of Richard Rathbun in the city of Washington early on the morning of July 16, 1918.

Richard Rathbun was born in Buffalo, N. Y., on January 25, 1852, and there studied in the public schools until he reached the age of fifteen years, when he entered the service of a firm of contractors, with which he remained for four years, acquiring a thorough knowledge of business methods, that was of special value to him during his later years.

At that time, attracted by the specimens of fossils that abound in western New York, he began the study of paleontology to which he assiduously devoted his evenings and holidays. The collection in the Museum of the Buffalo Society of Natural Sciences was made by him and he was appointed curator of that subject with charge of its collections by the society.

In 1871, he met Charles Fred. Hartt, then professor of geology at Cornell University and a pupil of the elder Agassiz, who persuaded him to give up business pursuits and devote himself to science. Young Rathbun accordingly entered Cornell and followed the regular academic course with the class of '75, specializing, however, in geology and paleontology.

The collections of Devonian and Cretaceous fossils previously obtained by Hartt in Brazil were assigned to him to work up and resulted in the publication of his first paper: "On the Devonian Brachiopoda of Ereré, Province of Pará, Brazil," in the *Bulletin of the Buffalo Society of Natural Sciences* for 1874[1] followed by a "Preliminary Report on the Cretaceous Lamellibranchs collected in the Vicinity of Pernambuco, Brazil," in the *Proceedings of*

[1] Vol. 1, pp. 236–261.

the Boston Society of Natural History for 1874.[2]

In the preparation of his paper on the Devonian fossils, he spent some time in Albany, N Y, where he came under the influence of James Hall, the state geologist of the great Empire state; and later while completing the paper on the Cretaceous fossils he studied at the Museum of Comparative Zoology, where he was so fortunate as to be able to attend a course of lectures by the elder Agassiz, then in the last year of his life.

Cambridge proved a congenial environment, and so instead of returning to Cornell, he continued at the Museum of Comparative Zoology from 1873 till 1875, acting also as assistant in zoology at the Boston Society of Natural History. During the summer months of those years he served as volunteer scientific assistant under Spencer F. Baird in the marine explorations of the U. S. Fish Commission on the New Engand coast, and thus began his connection with the Smithsonian Institution, for at that time the scientific work of the Fish Commission was practically under the direction of the Smithsonian.

In the autumn of 1875 he received the appointment of geologist to the Geological Commission of Brazil with orders to report to Professor Hartt in Rio de Janeiro, and with that service he continued until March, 1878. His first field work was in the region about the Bay of Bahia, and continued thence down the coast of the Province of the same name to near its southern end. Extensive deposits of coal said to occur in parts of that region constituted one of the special objects of the exploration, but the geology was studied in every particular, including the extensive coral reefs that lie along the coast, and also the ethnology of the Indian tribes living inland. The report on the geology and coral reefs was pubished in the Archives of the National Museum of Rio de Janeiro in 1878.[3]

Later he explored the central and southern parts of the province of São Paulo for the purpose of determining the mineral, and especially the coal, resources, and while these proved to be unimportant, he had the opportunity of studying the origin of the rich red lands where the famous coffee of that region is grown.

On returning to the United States, Mr. Rathbun brought with him complete series of the Devonian and Cretaceous fossils which have since become the property of the U. S. National Museum. It had been his hope to have monographed this interesting material, but other duties claimed his attention and with the exception of a few papers such as "A List of the Brazilian Echinoderms, with Notes on their Distribution," which he contributed to the *Transactions of the Connecticut Academy of Arts and Sciences* for 1879,[4] the material was worked up by other scientists.

Meanwhile he had accepted from Secretary Baird the appointment of scientific assistant in the U. S. Fish Commission with which Service he then continued until 1896. At first the collections of the Fish Commission were preserved in the museum of Yale University in the custody of Professor A. E. Verrill, to whom he was detailed as assistant, serving also at that time as assistant in zoology at Yale University.

In 1880, owing to the approaching completion of the U. S. National Museum building, Mr. Rathbun was transferred from New Haven to Washington and brought with him a part of the collections which had been stored at the former place. At that time he was made curator of the department of marine invertebrates in the National Museum, an appointment which he continued to hold until 1914.

As the Fish Commission grew, much of the administrative work was assigned to Mr. Rathbun by Secretary Baird and the responsibility steadily increased until Baird's death in 1887. Meanwhile, although Professor Verrill of Yale was the nominal head of the summer investigations of the Fish Commission, during much of the time Mr. Rathbun had active charge of the laboratories, steamers, and equipment and was responsible for the general management

[2] Vol. 17, pp. 241–256.

[3] Vol. 3, pp. 159–183.

[4] Vol. 5, pp. 139–158.

of the work. The collections were mostly assorted under his supervision for distribution to specialists. His own studies at that time related to the commercial fisheries and to the working up of the natural history of several groups of invertebrates.

During 1880 and 1881 he was employed upon the fishery investigations of the Tenth Census and reported on the natural history of, and the fisheries for, the commercial lobsters, crabs, shrimps, corals and sponges; the marine fishing grounds of North America with the ocean temperatures of the Atlantic coast of the United States. Much of this material appeared in "The Fisheries and Fishery Industries of the United States," which was prepared through the cooperation of the Commissioner of Fisheries and the Superintendent of the Tenth Census under the direction of George Brown Goode. Mr. Rathbun's contributions to these official reports amounted to 550 quarto pages with 106 plates.

Incidental to his work at this period was his association with colleagues in the gathering of material for the Great International Fisheries Exhibition held in London in 1884. He prepared and described the "Collection of Economic Crustaceans, Worms, Echinoderms and Sponges"[5] and he was the author of the "Descriptive Catalogue of the Collection illustrating the Scientific Investigation of the Sea and Fresh Waters."[6]

In 1891, at the request of the Secretary of State, he assisted John W. Foster in preparing material for the United States case at the Paris fur seal tribunal. He had the services of several experts, and was called to report upon the laws of all nations relating to the extra-limital fisheries for whales, hair seals, fisheries, precious corals, pearls, beche de mer, etc., and also upon the distribution and habits of these forms. Reports of progress were made daily to Secretary Foster, and the more essential parts of the completed report were incorporated in the extended brief of the American agent.

During the entire period of the fur seal inquiries Mr. Rathbun was in charge of the investigations, except those of the first international commission. The steamer *Albatross* made yearly trips to Bering Sea with one or more experts, who were directed to study the habits of these animals, and to make an annual comparative record of their distribution and numbers by written notes and identical series of photographs. The work was also extended to the Russian islands.

The most important international commission to the Fur Seal Islands was the one despatched in 1896. This expedition, with the cooperation of the Secretary of State, was conducted by the Treasury Department. Charles S. Hamlin, then Assistant Secretary of the Treasury, was in immediate charge of the case, and Mr. Rathbun was called to be his chief adviser. The latter was asked to become the head of the American Commission, but, declining, was requested to nominate its members, which he did. Mr. Rathbun also prepared the instructions for the commission, which entered into every detail and every accusation on the part of Canada.

In December, 1892, Mr. Rathbun was appointed by President Harrison as the American representative on the Joint Commission with Great Britain to study the condition of the fisheries in the boundary waters between the United States and Canada and the sea coast waters adjacent to the two countries, and to report such measures as might be deemed necessary to insure the protection of these fisheries. No similar investigation of such magnitude and importance was ever before attempted and four years were required for its accomplishment. A large party of experts was put in the field on the part of the United States, and Canada assisted to the extent of its facilities. Mr. Rathbun personally visited every point of interest, starting with the Gulf of St. Lawrence, continuing through the fresh water systems, including the Great Lakes, and ending at Cape Flattery at the west. The report, submitted to the Department of State on December 31, 1896, was transmitted by the President to Congress and printed.

It had been Secretary Baird's intention to

[5] Bull. 27, U. S. Nat. Mus., pp. 107–137.

[6] *Idem*, pp. 511–622.

have Mr. Rathbun transferred to the National Museum so that he might give his entire time to the development of the department of marine invertebrates and the working up of the important collections that were constantly being received, but on the death of Baird in 1887, Dr. G. Brown Goode, who succeeded temporarily to the office of Fish Commissioner, persuaded Mr. Rathbun, in consequence of his long experience and familiarity with the work, to remain with the commission. Later, when Colonel Marshall McDonald became permanent commissioner, he was equally appreciative of Mr. Rathbun's valuable qualities and likewise was able to induce him to remain with the bureau until his own death in 1895.

In 1896, on the invitation of Secretary Langley, he accepted appointment in the Smithsonian Institution, and on January 1, 1897, began his duties as Assistant in charge of Office and Exchanges. Before the expiration of the month his abilities were so manifest and his appreciation of the conditions so complete that he was made Assistant Secretary. This place he then held until July 1, 1898, when, still continuing as Assistant Secretary, he was given charge of the National Museum, in which capacity he remained until his death.

It is almost impossible to attempt to consider in detail the many ramifications of the great work that he accomplished, and naturally the minor, but certainly not unimportant, interests are obscured by the larger events to which he gave the later years of his life.

The most important of these was the construction of the new building, in which the natural history collections are preserved. His intense interest in this undertaking, as well as his remarkable capacity for studying details, is perhaps best shown by his careful preliminary study "The United States National Museum. An Account of the Buildings occupied by the National Collections," that appeared in the annual report of the U. S. National Museum for 1903.[7]

The years of patient watching and waiting for the completion of the structure, with his perfect knowledge of every detail, can never be satisfactorily told in words, but they are strikingly illustrated by the careful "Descriptive Account of the Natural History Buildings of the U. S. National Museum" that forms No. 80 of the Bulletin series,[8] that he published in 1913 on the completion of the building.

These two publications show how much he gave of himself to the perfection of a work that must always remain as the greatest monument that can be reared to his painstaking genius.

With an interest equal to that shown by him in the construction of the new museum building, he undertook the development of the National Gallery of Art, an important feature of the Smithsonian Institution, which although the one mentioned first in the fundamental act, had remained dormant for lack of adequate facilities. The valuable collection of paintings and art objects bequeathed by Mrs. Harriet Lane Johnston in 1903 to the National Gallery of Art afforded an opportunity quickly appreciated by Mr. Rathbun, who, recognizing its importance, began at once to plan for the building up of a great national art gallery. In 1904, the Freer collection with its unique specimens of Whistler's art work, was tendered and accepted by the Institution, and in 1907, William T. Evans began his gifts of selected paintings by contemporary American artists, which number more than 150 canvases and an equal number of other art objects. With these and other gifts the National Gallery of Art has "attained a prominence that has brought world-wide recognition." A permanent record of this development has been left by Mr. Rathbun in Bulletin No. 70 of the U. S. National Museum, under the title of "The National Gallery of Art, Department of Fine Arts of the National Museum,"[9] a volume remarkable for its artistic appearance, to every detail of which he gave his personal attention.

His natural taste for research and his tendency to go to the bottom of things led him to make elaborate studies on the collections, and

[7] Pp. 177–315, pls. 1–29.

[8] Pp. 1–131, with plates 1–34.

[9] First ed., 1909, pp. 1–140, pls. 1–26; 2d ed., 1916, pp. 1–189.

he has left behind him a valuable series of notes from which the future historians will find little that is lacking concerning the early history of the museum. At times interesting developments presented themselves, and as typical of those his last important publication may be cited. It was "The Columbian Institute for the Promotion of Arts and Sciences. A Washington Society of 1816–1838, which established a Museum and Botanic Garden under Government Patronage" (pp. 1–85), which was published as No. 101 of the Bulletin series of the National Museum in 1917.

Subsequent to the death of Secretary Langley, in February, 1906, and until the election of his successor a year later, Mr. Rathbun served as acting secretary, and frequently during the absence of Secretary Walcott the guidance of the affairs of the parent institution was entrusted to Mr. Rathbun as acting secretary.

His bibliography numbers nearly one hundred titles, and, in addition to those already mentioned, he was the author of various scientific papers contributed to the serial publications of the Fish Commission and the National Museum, as well as a few biographies of friends and colleagues, such as Charles F. Hartt and Jerome H. Kidder; several popular articles contributed to current literature; and a series of official reports of which, notably those of the National Museum, are conspicuous evidences of his patient industry.

Intense devotion to duty was a striking trait of Mr. Rathbun's character, and so, absorbed in the details of his various activities, all of which had to do with the institution to which he gave his life, he had but little time for other interests.

Nevertheless, his scientific work gained deserved recognition from Indiana University, which in 1883 conferred upon him the degree of M.S., and in 1894 Bowdoin gave him her doctorate in science.

His colleagues found pleasure in dedicating in his honor recently discovered forms of life, and a genus of fishes, *Rathbunella* ("in recognition of his many services to science"), as well as a genus of starfish, *Rathbunaster* ("in appreciation of his pioneer work on Pacific starfishes") and many new species of plants, batrachians, fishes and mollusks preserve his name in the literature of science.

Naturally he was a member of many scientific societies. At home he was active in the Biological Society of Washington, and he was an early member of the Philosophical Society, becoming its president in 1902; also he was a member of the Washington Academy of Sciences, and in 1905 he was chosen by his associates to be president of the Cosmos Club, an honor that he greatly appreciated.

Among the national societies he was a fellow (since 1892) of the American Association for the Advancement of Science, corresponding member of the Boston Society of Natural History, member of the American Society of Naturalists, councilor of the American Association of Museums, and a member of the American Fisheries Society.

His foreign connections included membership in the Fisheries Society of Finland, the Russian Imperial Society for the Acclimatization of Animals and Plants, and corresponding membership since 1917 in the Zoological Society of London.

Mr. Rathbun was also a permanent councilor of the International Fisheries Congress, a member of the American Committee for the Boston meeting of the International Zoological Congress, and in recent years every gathering of scientists, such as the International Congress of Applied Chemistry, the International Congress of Americanists, and the Second Pan American Scientific Congress held in Washington, placed his name on their honor lists of distinguished members.

At a memorial meeting of the various members of the staff of the Smithsonian Institution and its branches, held in the National Museum on the day of Mr. Rathbun's death and presided over by Mr. Henry White, a regent of the institution, record was made of "their profound sorrow at the loss of a sincere friend, an executive officer of marked ability, and one whose administration has had a wide influence upon the scientific institutions of the nation."

Marcus Benjamin

THE OLONA, HAWAII'S UNEXCELLED FIBER-PLANT

THE Hawaiian people formerly made use of a considerable range of fiber plants. Some of these were brought by the natives from the South Pacific, others were discovered in the new island home. The paper mulberry, *Broussonettia papyrifera,* is an excellent example of a fiber-plant widespread in the Pacific region. From its copious bast was made the typical *kapa* or bark-cloth of Polynesia. The *olona* (*o-lo-na*) *Touchardia latifolia* Gaud., on the other hand, is wholly confined to the Hawaiian Islands; the genus is monotypic and endemic. The ancient Hawaiians undoubtedly discovered the valuable fiber of this plant at a very early time. They were intimately familiar with the local flora and its economic utilization. The *olona* is mentioned in many of the old songs and legends.

Special interest is attached to the *olona* fiber as it is generally recognized *to be the strongest and most durable fiber in the world.* No other fiber is recorded to exceed it in these two important characteristics. So far as is known to the writer, the present paper is the first and only extant concise and comprehensive account of the *olona.*

The urticaceous genus *Touchardia* was named and described by Charles Gaudichaud-Beaupre, generally known as Gaudichaud. He was botanist for the great French expedition under Freycinet, 1817–1820, and for "La Bonite" during its circumnavigation of the globe, 1836–37. The botany of the latter voyage, in which *Touchardia* is described, was published under the title "*Botanique du Voyage autour du Monde . . . sur la Bonite.*" The salient features of the genus are as follows: Flowers diœcious, on globose receptacles. Male perigone 5-parted, the segments imbricate in the depressed bud. Stamens 5. Female perigone subcampanulate, 4-lobed or toothed. Ovary straight, almost as long as the perigone. Ovule oblique, ascending. Stigma spathulate, with one face and the margins papillose-ciliate. Achene smooth, compressed, oval, invested by the rather fleshy adherent perigone. Albumen very scanty. Cotyledons ovate, subcordate, conduplicate, and twice as long as the thick radicle.

The single species *latifolia* was named with reference to the large, broad leaves, which form a conspicuous feature of the plant. It is an erect woody shrub, 4–10 ft. high, and sparingly dividing into stout branches. It is from the thick bark of these wand-like erect shoots that the highly prized fiber is obtained. The youngest shoots are hispid, but soon glabrate; the colorless latex is viscid and not plentiful.

The leaves are alternate, large, and with petioles of 3–10 inches. The upper leaves have short petioles, the lower leaves have greatly elongated petioles. The leaf-blade is 9–16 inches long by 5–10 inches broad, ovate, with acute or acuminate apex and rounded base. The margin is obtusely crenate. The blade is chartaceous, dark-green on both faces, and glabrous, excepting a few small hairs along the veins. Unlike many urticaceous plants, the leaves are not armed with stinging hairs. The veins are conspicuously tripli-venate at the base of the leaf, the lateral veins not reaching the middle of the margin; toward the apex it is pinnate, with rectangular areoles. The stipules are large, 2 inches long, axillary, entire and acute. They form one of the easily recognized characters of the plant. The midribs, petioles, stipules, etc., are often dark red.

The flowers are pedicellate and bracteolate. The globose glomerules are generally arranged in repeatedly forking cymes, with one branch suppressed and the middle glomerule sessile. The male cymes are longer (3–5 in.) and broader (5–6 in.) than the female cymes, which are also more crowded. The male glomerules are 6–8 lines in diameter, with a perigone of 1½–2 lines, the lanceolate segments hooded and obtuse or tuberculate below the apex. The stamens are shortly exerted; anthers large, white. The rudiment of the pistil is glabrous. The female glomerules are 4–5 lines in diameter; perigone 1 line diameter, orange-colored upon maturity; style as long as the achene. Like many of the plants of the rain-forest the *olona* is quite variable as to its flowering period; flowering plants may be obtained at any season of the year.

The natural habitat of the *olona* is the lower and middle forest zone, lying on the mountains between elevations of 800–1,800 feet. It is strongly hygrophytic and shade-loving; it never occurs naturally in the open or in dry sections. The favorite habitats are deep, cool, gloomy ravines, or moist slopes that are well screened by forest cover. The *olona* belongs to that ecologic section of the Hawaiian flora that luxuriates in the dense moist shade of the montane forests. The zonal limitations of *olona* are clean-cut; it does not occur on the lowlands, nor at the higher levels. It inhabits all of the larger islands of the archipelago. Representative regions are the rain-forests of Wai-ale-ale, Kauai, Waianae and Koolau Ranges, Oahu; East Molokai; West Maui and Hale-a-ka-la; and the extensive forests on the island of Hawaii. It occurs in little patches or thickets here and there in the forest, but is nowhere abundant. It does not form continuous stands; reproduction is not vegetative but apparently always from seed. In any one spot the collector is not likely to find more than a few score individual plants.

The Hawaiians formerly cultivated the *olona* in a primitive manner. They did not prepare the land or plant seed, but merely searched out good patches of the wild plants. Such a patch was cleared of any obstructing vegetation, not disturbing, however, the large trees which shaded the plants. If the *olona* plants were too crowded they were thinned out. The old plants were pruned so as to give a number of young, straight shoots.

At irregular intervals, as convenience or necessity dictated, the grove was visited and the crop harvested. This process consisted in cutting all the long, straight shoots that had reached a diameter of about one inch. The bark of such shoots was rich in bast fibers, and these were of maximum length. Six feet was an average length. The bark was carefully stripped from the wands, in one or more pieces, packed into rolls or bundles, and carried down to the settlements on the lowlands, where the final operations were performed.

A suitable situation was found along a stream or irrigation ditch. The bundles of bark were opened and spread out in the shallow running water, where they were allowed to partially macerate. This required several days; then the long strips were removed from the water and the remaining pulpy matter was scraped from them while still wet. The scraping was performed on a long, narrow, hardwood board, specially devised for this purpose and known as "*la-au kahi olona.*" The scraper was made of pearl shell (*Margaritifera fimbriate*) or turtle-shell plate (*Chelone mydas*), and was called "*uhi kahi olona kau honu.*" The prepared fiber was carefully dried and rolled into cordage of various sizes.

In ancient Hawaii the *olona* was venerated as a sort of deity or lesser god. Before spinning the fibers the natives made libations, and offered sacrifices of hogs, fowls, etc. The following excerpt of an old chant—the *mele* of Kawelo—vividly describes the preparation of the *olona* fish-net:

> I, as chief, willingly
> Cast my net of *olona;*
> The *olona* springs up, it grows,
> It branches and is cut down.
> (The paddles of the chief beat the sea.)
> Stripped off is the bark of the *olona,*
> Peeled is the bark of the yellow *moki.*
> The fire exhales a sweet odor;
> The sacrifice is ready.
> The bark is peeled, the board is made ready,
> The *olona* is carded
> And laid on the board.
> White is the cord.
> The cord is twisted on the thigh,
> Finished is the net!
> Cast it into the sea,
> Into the Sea of Papa; let him fall,
> Let him fall, that I may strangle the neck
> Of Uhumakaikii.

Uhumakaikii was a legendary sea-monster, who could raise great waves and capsize canoes.

Formerly every chief had in the mountains one or more plantations of *olona,* which were tended by his dependents and which supplied him with sufficient quantities of this valuable product. Taxes were not infrequently paid with *olona,* as the fiber was nowhere so abundant as to depreciate its exchange value.

Among the Hawaiians it was put to a great

variety of uses. All fishing lines and nets of the best quality were invariably made of *olona*, because of its high resistance to the action of salt water. *Olona* lines and nets which have been in more or less constant use for over a century are almost as good as new, and are handed down from generation to generation as precious objects. Most of the natives are very unwilling to part with any of their fishing gear that is made of olona. The very serviceable carrying-nets, *koko*, in which the wooden calabashes and other objects were borne, were commonly made of *olona* fiber. *Olona* was not used for making the bark-cloth or *kapa* itself. but threads and cords of *olona* were used for sewing the *kapa*. A stout cord of *olona* was usually attached to the wooden war-clubs and dagger-like swords, for suspending the weapon from the wrist. This prevented the loss of the weapon during the fray. For fastening the stone adz, *oo*, to its wooden handle, *olona* was always the preferred fiber.

It was used for the very fine and pliable netting which served as a groundwork for the feathers, in the construction of the splendid garments and insignia of the ancient royalty and *alii*. The brilliant scarlet and yellow feathers were skillfully woven by the women upon the imperishable framework of *olona*.

Mr. William Weinrich, manager of the Hawaiian Sisal Company's extensive plantation, has made an exhaustive study of fibers in the Hawaiian Islands, and has kindly prepared for the writer the following statement concerning *olona:*

> This fiber not only partakes of all the best characteristics of this genus, but is superior to any of its members, producing the best of all fibers known at the present time. The three dominant features are
>
> First—the great tensile strength. I estimate that the strength of *olona* is about three times the strength of commercial Manila. The statement is made that *olona* is about eight times as strong as the hemp, *Cannabis sativa*. So far as I can gather, this great strength is due to the unusual length of the cell in proportion to its width.
>
> Second—its great resistance to deterioration in salt water. I once examined a ball of *olona* fish-line, the Hawaiian owner of which stated that it had been in their family, and in constant use, for over fifty years. At the time I saw it, the fiber was in an excellent state of preservation.
>
> Third—its pliability, and thus its adaptability for spinning by hand. Fishing lines and nets made from this fiber by expert Hawaiians present an appearance of so uniform a caliber and twist that it would lead one to believe that the fiber had been made by the most intricate machinery.
>
> It was the writer's pleasure, some years ago, to send samples of the *olona* fiber to the manufacturers in the East. To my surprise, the fiber was found to be absolutely unknown in that market.
>
> A fiber with these characteristics should be exploited to the fullest measure. The extraction of this fiber is not a difficult process. In the history of Hawaii we find references to this fiber as having been grown on a large scale as a source of revenue; but, like many other things Hawaiian, its usefulness has been lost sight of during the progress of civilization.
>
> The key to the situation lies in transforming this plant from its wild state to a cultural form. When this is done, the world will be in possession of a new fiber, having a greater tensile strength, weight for weight, than any other fiber known.

Vaughan MacCaughey

College of Hawaii,
Honolulu

THE BARBADOS-ANTIGUA EXPEDITION FROM THE STATE UNIVERSITY OF IOWA

The Barbados-Antigua Expedition from the State University of Iowa returned to New York on August 1, with all its members in good health and without mishap of any kind.

There were nineteen persons in the party, nearly all of them instructors or graduate students from the State University of Iowa. Their object was not only to secure collections in marine zoology, entomology and geology from a region in which little work had hitherto been done; but also to study the living forms in and around the islands visited and thus supplement the future more intensive work based on the collections secured.

In both Barbados and Antigua the colonial authorities provided excellent quarters for the party and adequate laboratory facilities in government buildings, and both officials and

private citizens aided the enterprise in every possible way.

At Barbados dredging was accomplished at about one hundred stations, working down to over 150 fathoms. This was rendered possible by the use of a fully equipped 27-foot launch provided by Mr. John B. Henderson, of Washington, who accompanied the expedition and who will report on the collections of Mollusca of which many new or rare forms were taken.

Practically all species taken with the dredge or tangles will provide new locality records extending the known geographical range. The fauna, while not so rich as that of the western end of the Antillean chain, or the continental shelf off the Florida Keys, is of remarkable interest from a distributional standpoint, while a number of new forms will interest the systematist. The apparent scarcity of certain groups abundant in the western parts of the West Indies, such as the Asteroidea, was something of a surprise. As is usually the case in a region of growing corals the cœlenterate fauna was most conspicuous, but there seemed to be a remarkable scarcity of medusæ. Indeed the pelagic fauna was rather poor.

Shallow water forms, on the contrary, were remarkably abundant and interesting, furnishing ample material for laboratory work and study of forms *in situ*. Some probably new forms of actinians and corals were secured. *Balanoglossus* was found in the sand near our laboratory on Pelecan Island.

By employing a native diver many species were secured at depths from three to nine fathoms. Some remarkably fine corals and alcyonarians were thus obtained. The use of fish-pots and native fishermen resulted in a fairly complete set of reef fishes which would not otherwise have been secured. Very few deep-water fishes were taken.

Many gorgeously colored comatulics were dredged, but the pentacrinoids were represented by but a single *Rhizocrinus*. The serpent stars were, as usual, very abundant and a number of simple-armed basket-fish were found. Crustacea were, of course, particularly numerous, perhaps the most interesting being small macrourans secured by breaking up old coral heads.

At Antigua the party was given quarters at the old dock-yard at English Harbor, a formidable naval base in Nelson's time. Here the conditions were entirely different from those at Barbados. The trade-winds were so strong and constant during our stay that little dredging could be accomplished, and the entire time was devoted to shallow-water forms in English Harbor, Falmouth Harbor and Willoughby Bay. These waters were over mud bottoms; the shores, however, being varied in the form of mud flats, mangrove swamps, sand beaches and rocky shores. Here were found a veritable wealth and variety of aquatic forms, a great majority being different from those secured at Barbados.

Tube-dwelling worms, some of great size and beauty, were perhaps the most striking feature; tunicates and holothurians coming next in point of abundance both in individuals and species. Among the Mollusca, a great quantity of beautiful *Murices* were collected off the sea wall, where they seemed to be devouring the soft parts of a bivalve (*Perna*) that was attached in great quantities near high-water mark. A very large Chætopod, called locally "sea scorpion," was found to bore through a heavy *Livona* shell, making a hole as smooth as a drill.

Large and wonderfully beautiful anemones of several species were abundant, particularly in Falmouth Harbor, as well as the finest colonies of *Pennaria* that I have ever seen. The Echinoidea were well represented, mostly by well-known forms.

One small spatongoid was found to live buried from six to twelve inches under the sand. Among the Crustacea, a very large land-crab, with orange brown carapace and purple and white chelæ, was perhaps the most striking form.

At both Barbados and Antigua extensive collections were made in the field of geology by Professor A. O. Thomas. Mr. Henderson made a practically complete collection of land mollusks, while Mr. and Mrs. Dayton Stoner did faithful and successful work in the entomological field, in which they were very materially aided by both the local and imperial departments of agriculture. The field of

botany had no professional representative in the expedition; but considerable collecting and field work done by Mr. Willis Nutting. A fine series of two species of bats were secured at Antigua.

As already indicated, Mr. John B. Henderson will report on the Mollusca. The reef fishes will be reported on by Dr. Barton W. Evermann, Professor W. K. Fisher will attend to the Asteroidea and Holothuroidea, while the writer will probably report on the Hydroida and Alcyonaria. The other groups have not as yet been assigned.

A large series of excellent photographs, including moving picture films, was secured by Mr. Maurice Ricker, official photographer of the expedition.

C. C. NUTTING

STATE UNIVERSITY OF IOWA,
August 30, 1918

SCIENTIFIC EVENTS

THE JOURNAL OF THE AMERICAN CERAMIC SOCIETY

A JOURNAL that is a pioneer in its field is always the subject of most careful scrutiny. When that field is representative of one of the oldest phases of human endeavor the cause for attention to the new publication is multiplied many fold. There has now appeared the first issue of the *Journal of the American Ceramic Society*, a monthly journal devoted to science and technique of the ceramic industries.

The American Ceramic Society belongs to the older family of scientific societies in the United States. The first meeting of the society, which was in reality a little family gathering of a small group of ceramic enthusiasts, was held in Columbus, Ohio, in February, 1899, and from that meeting grew the present organization due largely to the guiding genius of Professor Edward Orton, Jr., of Ohio State University. The society is, therefore, in its twentieth year of vigorous and active life. The membership has increased from that early day until at present there are over 1,000 enrolled in the society.

In the American Ceramic Society, the term ceramic is synonymous with "silicate industries" and the interests and activities of the society include all branches of the clayware, glass and cement industries as well as enameled wares of all kinds and in addition other closely allied products are included, chief among which are abrasives, gypsum and lime. Few people realize the gigantic proportions of these ceramic industries. The products of the three major divisions alone (clayware, glass and cement) aggregate over $400,000,000 per annum.

In the earlier days the society consisted of one main organization only. With increased activities and with enlargement in its scope of usefulness it became necessary to organize local sections and student branches as shown in the following list.

LOCAL SECTIONS

St. Louis Section
Chicago Section
Central Ohio Section
Northern Ohio Section
West Virginia Section
Beaver Section
New England Section
New York State Section
New Jersey Section
Pacific Coast Section

STUDENT BRANCHES

Ohio State University Student Branch
New York Student Branch
University of Illinois Student Branch
Iowa State College Student Branch

The publication work of the society has, up to the present time, been confined to the issuing of our annual volume of *Transactions*. Twenty years ago this was a small feeble effort, very creditable for the then-existing state of our knowledge of the science of the silicate industries. This annual volume has shown continuous growth and the 1917 volume comprises 707 pages of well-edited contributions. The American Ceramic Society's *Transactions* have, for many years, been known throughout the world as the standard reference books on the silicate industries.

This remarkable growth in strength and influence of the society has made it essential that periodical publication of the researches and other activities of the society members be

undertaken and the monthly *Journal of the American Ceramic Society* is the logical result.

The first number is a very attractively prepared journal of seventy-two pages. It is well edited and well printed on good paper. The contents of the first number are as follows:

The present officers of the society are:

President—Homer F. Staley,
Vice-president—A. F. Greaves-Walker,
Treasurer—R. K. Hursh,
Secretary—Charles F. Binns,
Trustees—
A. F. Hottinger,
E. T. Montgomery,
R. D. Landrum.

Membership in the society is open to any one interested in any branch of the ceramic industries and application should be made to the society. All members receive the *Journal* gratis.

C. F. B.

ENGLISH VITAL STATISTICS

THE *Journal* of the American Medical Association reports that the English registrar-general's seventy-ninth annual report on vital statistics for the year 1916, which has just been published, is of unusual interest, because in that year the war existed long enough to affect the figures considerably. The birth rate was 20.9 per thousand living, and was the lowest on record. It was 4.6 below the average for the ten years 1905–1914 (which were practically unaffected by the war). On the whole, the reduction of natality, which amounted to about 12 per cent. on the figures for 1914, is less than might have been expected, and compares favorably with the experience of other belligerent countries. The civilian death rate was 14.1 per thousand living, and was slightly below the average of the decennium before the war. The rate of 1916 is considered to be the lowest recorded, provided allowance is made for the effect of enlistment on the population. The standardized mortality of males ordinarily exceeds that of females. Up to 1860 the excess was not more than 9 per cent.; but in 1916, in consequence of the war, the excess amounted to 32 per cent. The most remarkable feature is the low death rate in the first quinquennium of life. It was much lower than any previously recorded, and was less than half the rate prevailing in the concluding years of the last century. The all-age mortality from typhoid and from scarlet fever was the lowest on record, while diphtheria and influenza were more fatal than the average. But the death rate from tuberculosis showed a further advance on the high rate of 1915, although the increase did not extend to young children, the mortality under 5 years being the lowest hitherto recorded. Cancer was more fatal in 1916 than in any other year, and cerebrospinal fever continued to be abnormally destructive. In view of the loss of life in the war statistics of childhood are of unusual importance. The births in England and Wales in 1916 were in the proportion of 1,049 males to 1,000 females, against 1,033 to 1,000 in the preceding five years. This proportion is by far the highest recorded during the last half century. It certainly bears out the old view, regarded by some as a superstition, that war increases the proportion of male births because nature endeavors to compensate for the loss of male life in warfare. Of the deaths at all ages, 41.1 per cent. were those of infants under the age of 1 year. These deaths correspond to a mortality rate of 91 per thousand births, the lowest ever recorded. It was below the average in the preceding decennium by 20 per cent. This decline was in part due to low diarrheal fatality, but the greater part of it is accounted for under other diseases less subject to climatic

influences. The mortality in infants from tuberculosis was 2.39 per thousand births, much the lowest on record.

WAR COMMITTEE OF TECHNICAL SOCIETIES

There has been organized a war committee of technical societies consisting of the following members: American Society of Civil Engineers, Nelson P. Lewis, Major James M. Boyle; American Institute of Electrical Engineers, Harold W. Buck, Dr. A. S. McAllister; American Society of Mechanical Engineers, Professor A. M. Greene, Jr., R. N. Inglis; American Institute of Mining Engineers, David W. Brunton, Edmund B. Kirby; American Gas Institute, Dana D. Barnum, E. C. Uhlig; American Electrochemical Society, Joseph Bijur, Dr. Chas. A. Doremus; Illuminating Engineering Society, Louis B. Marks, Preston S. Millar; Mining and Metallurgical Society of America, Christopher R. Corning, George C. Stone; American Society of Refrigerating Engineers, Henry Torrance, F. E. Matthews; American Institute of Chemical Engineers, Dr. Chas. F. McKenna, Frank E. Dodge.

The chairman, D. W. Brunton, has addressed the following letter:

The men who, at the call of patriotism and duty, have joined the colors, are not only risking their lives, but are cheerfully sacrificing their careers and in many instances their financial interests to protect the honor of the nation. It, therefore, becomes the duty of those of us who, for various reasons, are unable to enlist, to do something more than our share in keeping the machinery of industry moving.

Other wars have been fought only on land and sea, but in this conflict the combatant areas have been greatly extended by the advent of submarines, flying machines and even subterranean warfare. In previous wars the armies and navies of belligerents were practically the only forces engaged; in this war the full economic strength of nations is drawn into the contest and every branch of scientific and industrial effort is taxed to the utmost.

Intensifying production and conserving the supply of food and clothing constitute service within the reach of all, but the engineers, electricians and chemists of this country can go a step further and utilize their technical training to develop such new devices and improvements, equipment and methods as will give our Army and Navy that superiority which will assure victory.

Inventive talent in this country is by no means confined to the membership of our societies; members who have employees or acquaintances of an originative turn of mind should make an effort to stimulate that most useful talent by passing on to such persons the bulletins as they are received, and also by calling attention to the numerous ably written articles on the mechanical phases of the war, published in technical and popular magazines.

In the world-conflict which is going on to-day the three dominating factors, the submarine, the automatic machine gun and the flying machine, are all American inventions. This nation is still in its youth and can therefore be expected to do in future still greater things than it has done in the past. War is a new occupation to us, but under the stimulus and pressure of its necessity, we should advance as far in the arts of war during the next two years as we normally would in twenty.

Some of the civilian engineers of this country are now rendering great service to the government through the agencies of the Council of National Defense, the Naval Consulting Board, the National Research Council and their numerous auxiliary committees, but unfortunately only a small proportion of the technical men of this country are so situated that they can go to Washington and engage in this service; therefore, some means of utilizing the patriotism and originative thought of our members had to be devised.

For this purpose the War Committee of Technical Societies has been organized, and it hopes to give the members of the technical societies who are obliged to stay at home, an opportunity to use their inventive talent and technical training in the study of the varied problems which arise in the preparation for and prosecution of the war—thus making valuable contributions to the national cause.

The greatest care will be taken to discover and utilize everything of value that may inhere in suggestions and inventions submitted. Not only will they receive studious examination, but when necessary, trials and experiments will be conducted. All inventions which have successfully passed the necessary examinations and tests are turned over to the particular department of the Army and Navy Service where they may be most profitably utilized.

D. W. Brunton,
Chairman

THE NEED FOR NUTRITION OFFICERS IN MILITARY CAMPS

The Surgeon-General has been authorized to station in each of the larger military camps and cantonments in this country a nutrition officer whose duties will be those of an adviser to the camp commander, the camp surgeon and the camp quartermaster on all matters relating to the nutritive value of foods. There is still need for a considerable number of men well trained in food chemistry and physiology of nutrition, who can qualify as lieutenants and captains in the Sanitary Corps for this assignment. Upon receiving commissions these officers will be given training for a period at the Medical Officers' Training Camp, Camp Greenleaf, Fort Oglethorpe, Georgia, and will then be subject to appointment as nutrition officers, or to duty of a similar nature overseas. This work has proved to be of signal importance in the interest of proper nutrition of the soldiers and of the economic use of foods both in this country and overseas. Application for information should be made to Lieutenant Colonel John R. Murlin, Sanitary Corps, Office of the Surgeon General, 7th and B Sts., NW., Washington, D. C.

The following officers of the Division of Food and Nutrition of the Medical Department, U. S. Army, are on duty overseas:

Majors Phillip A. Shaffer, A. J. Carlson, Ernest B. Forbes, John P. Street.

Captains Frank C. Gephart, Walter H. Eddy, Fred F. Flanders, J. Garfield Riley, Ernest L. Scott, Leon A. Congdon, H. A. Mattill, F. B. Kingsbury, Marion G. Mastin, Arthur W. S. Thomas, Drury L. Weatherhead.

Lieutenants Cleon C. Mason, Willard R. Line, C. A. Cajori, A. G. Hogan, S. C. Dinsmore, A. A. Reithwiesner, A. F. Wussow, F. J. Funk, L. V. Burton and A. A. Schaal, Sanitary Corps.

Lieutenants A. D. Shohl, Rolla B. Hill, R. W. Bury and A. T. Hipps, Medical Reserve Corps.

SCIENTIFIC NOTES AND NEWS

Dr. Edward A. Spitzka has been promoted to be lieutenant colonel in the Medical Corps, U. S. A.

Mr. William Bowie, hydrographic and geodetic engineer and chief of the division of geodesy of the U. S. Coast and Geodetic Survey, has been commissionel a major in the Corps of Engineers, U. S. Army and has been assigned to duty in the department of map making.

Professor Ross P. Anderson, of Cornell University, has received a captaincy in the Chemical Warfare Service of the United States Army and has been sent to France. For the last year, Captain Anderson has been absent from Cornell on leave, carrying investigations on the removal of gasoline from natural gas for the United Natural Gas Company, of Oil City, Pa. While at Cornell he had charge of the courses in gas analysis.

Captain J. F. McClendon, Sanitary Corps, U. S. A., has been ordered to Camp Fremont, Menlo Park, California, to serve as nutrition officer of that camp. He has leave of absence for the period of the war from his position as associate professor of physiology, University of Minnesota Medical School, Minneapolis.

A. H. Holt, of the college of applied science, University of Iowa, has been appointed captain in the Engineering Corps of the Army and is stationed at Camp Lee, Va.

Dr. Floyd K. Richtmyer, assistant professor of physics at Cornell University, has left Ithaca to accept a temporary civilian appointment as radio engineer in the Signal Corps of the United States Army at Washington. The appointment was made as a result of research work done by Professor Richtmyer this summer. He plans to return to Ithaca before the university reopens in October.

The experimental ammonia plant and laboratory of the Bureau of Soils at Arlington, Virginia, has been transferred to the Nitrate Division of the Ordnance Department of the Army. The work is in charge of Dr. R. O. E. Davis and Mr. L. H. Greathouse.

Dr. William T. McCarty has been appointed physical director of the aviation unit at Mineola, N. Y.

Mr. Stephen C. Bruner, formerly assistant pathologist at the Estación Experimental Agronómica, Santiago de las Vegas, Cuba, has been appointed pathologist to succeed Mr.

John R. Johnston, now head of the Office of Sanadad Vegetal, Habana.

Dr. Vern B. Stewart has accepted an appointment in the Bureau of Plant Pathology at Washington, and is now engaged in work on the pathological aspects of market inspection of vegetables.

Miss Zelma Zentmire has been appointed to fill the place of J. J. Hinman, water chemist and bacteriologist at the University of Iowa, who leaves soon for service in the Sanitary Corps of the Army.

H. F. Taylor, assistant for developing fisheries and for saving and use of fishery products in the Bureau of Fisheries, has visited Boston, New York, Pittsburgh and Chicago for the purpose of studying the equipment of industrial laboratories and the assemblage of equipment to be installed in the Bureau's laboratory when built.

The University of Pennsylvania expedition to the hitherto unknown Indian tribes in the mountains between Venezuela and Colombia in charge of Theodore De Booy, curator of the University Museum, has returned, having accomplished its purpose in a much shorter time than was believed possible. This was due largely to the assistance of the Venezuelan government.

According to a press dispatch Vilhjalmar Stefansson, arrived at Dawson, Yukon, on August 29. He is recovering from his serious illness and intends to make a Red Cross lecture tour, beginning in New York in October.

The Royal College of Surgeons, London, has accepted the invitation of the Royal College of Physicians to appoint a joint committee to consider the proposals for the establishment of a Ministry of Health. This committee has co-opted representatives of the Society of Medical Officers of Health, and Dr. Hamer, London, Dr. H. R. Kenwood, Chadwick professor of hygiene in the University of London, and Dr. Robertson, Birmingham, will join the committee. The representatives of the college of physicians are the president, Dr. Norman Moore, Sir Bertrand Dawson, Sir J. F. H. Broadbent, and Dr. Ormerod (registrar). The representatives of the college of surgeons are the president, Sir George Makins, Sir Berkeley Moynihan, Mr. Waring and Mr. Ryall.

The trustees of Cornell University have passed resolutions in memory of Professor Henry Shaler Williams, in which they say:

As a teacher he was very conscientious; he was especially strong as a teacher in his laboratory, where his close personal attention and his constructive criticism gave his students a training of incalculable value.

As an investigator he attained a very high rank. His studies of Devonian paleontology, of the geological history of organisms, and of the evolution and geographical and geological modification of fossil faunas stand out as important contributions to the literature of these subjects. He was honored by election to the more important American and foreign geological societies.

Although his devotion to his students and his attainments as an investigator gave him eminence, yet to those of us associated with him he will be remembered especially because of his personality. His sweetness and gentleness of character and his thoughtfulness of others won him the love of all who were so happy as to know him.

Dr. Byron D. Halsted, for nearly thirty years professor of botany in Rutgers College and botanist for the New Jersey Agricultural Experiment Station, died at his home in New Brunswick, N. J., on the night of August 27, as the result of paralysis.

Professor F. P. Treadwell, the author of widely used text-books of analytical chemistry, died suddenly of heart-disease at his home in Zürich, Switzerland, on June 24 last. Treadwell was an American by birth (1857, Portsmouth, N. H.), but spent most of his life abroad. His professional activity after serving as Bunsen's lecture assistant from 1878 to 1871 was at the Eidgenössische Polytechnische Schule in Zürich.

The death is reported of M. Maurice Chevreux, the naval engineer. M. Chevreux laid claim to having drawn the plans of the first Zeppelin which succeeded in navigating the air.

The Board of Agriculture of Great Britain has made an order authorizing in England and Wales the killing on and after August 1, until

the next close season, of certain migratory wild birds to increase the food supply.

THE twelfth annual report of the British Science Guild has been published, and copies can be obtained (price 1s. each) on application to the secretary, British Science Guild, 199, Piccadilly, W. London. The report contains addresses by Lord Sydenham, Sir Henry Newbolt and Sir Algernon Firth, delivered at the recent annual meeting of the guild, with particulars of the British Scientific Products Exhibition which is being organized by the guild, and memoranda on the British dye industry, the introduction of the metric system, scholarships for higher education, the teaching of science and other subjects.

As has been noted in SCIENCE active steps are being taken with a view to the establishment at Cambridge of an Institute of Agricultural Botany, the primary function of which will be the breeding and distributing of improved varieties of agricultural crops. We learn from *Nature* that the scheme in question was very fully described by Mr. Lawrence Weaver, of the Board of Agriculture, at a meeting of the Agricultural Seed Association held on July 15. It appears that the new institute will be modelled on the famous Swedish plant-breeding station at Svälof, and that its activities will be to follow two distinct lines, one of which will be purely scientific, while the other will have a commercial outlook. More precisely, the scientific wing will be concerned with the producing of pure cultures of new varieties on the field-plot scale; the economic wing will deal with the growing and distribution on a large scale of these varieties. Presumably, on the Svälof model, the scientific side will oversee the operations of the commercial to the extent of guaranteeing the purity of the stocks distributed by the latter. It has been announced that subscriptions towards the establishment of the new institute amounting in the aggregate to upwards of £30,000, have already been received, including a sum of £10,000 down and £2,000 a year for five years from the firm of Sir Robert McAlpine and Sons. It has also been announced that the Board of Agriculture will provide the necessary buildings and equipment.

A TEMPORARY exhibition was opened in a few of the galleries of the British Museum on August 1. The exhibition galleries were closed by order of the government as a measure of economy in the spring of 1916, and, owing to the necessity of increased precautions against air raids, all the most valuable objects have been removed to places of greater safety. The trustees, however, have deeply regretted the closing of their doors to visitors, and especially to soldiers from the oversea Dominions. An exhibition has accordingly been arranged, consisting chiefly of casts and facsimiles, which it is hoped will both be instructive in itself and representative of some parts of the treasures of the British Museum. The exhibition will include Greek sculpture, classical coins, British coins and medals, historical documents and autographs (naval and military), illuminated manuscripts, early Bibles and other printed books of interest and beauty. If the experiment of reopening is successful, it may be possible to extend it later to other galleries of the Museum. The exhibition is open from 10 A.M. to 1 P.M. and from 2 to 5, each week day. A guide-book to the exhibition is in preparation and photographs and museum publications are obtainable in the entrance hall.

A SPECIAL general meeting of the Royal Society was called on July 31 to consider the advisability of expelling enemy foreign members, and notice of the following motion to be submitted to the meeting was given by Sir George Beilby and Dr. M. O. Forster:

> That, in view of the war having continued during nearly four years without any indication that the scientific men of Germany are unsympathetic towards the abominable malpractises of their government and their fellow-countrymen, and having regard to the representative character of the Royal Society among British scientific bodies, as recognized by the patronage of his Majesty the King, the council forthwith take steps necessary for removing all enemy aliens from the foreign membership of the society.

The London *Times* says: Although Sir George Beilby and Dr. Forster are both members of

the council this resolution is apparently not put forward by the council officially. The notice convening the meeting states that on July 4 the council had under consideration the question of expelling the enemy foreign members. They considered that, if possible, unity of action between the Allied nations should be secured, and in view of the fact that a conference between representatives of Allied academies will take place in October next they resolved to refer the question to that conference. In the meantime they desire to obtain the opinion of the Fellows of the society on the subject for the guidance of their representatives at the conference which has been called for the purpose of discussing the future of scientific work hitherto carried out by international organizations.

FROM a White Paper published on July 10 *Nature* reports that among the supplementary estimates for the year ending March 31, 1919, is the sum of £1,000,000 which is to be devoted through the Board of Trade to the purpose of assisting the dye-making industry. This is the first instalment of a total sum of £2,000,000 to be provided in the shape of loans and grants to be spread over three years, and divided as follows: £1,250,000 in loans at not less than 1 per cent. above the Bank rate, with a minimum of 5 per cent., repayable in twenty years or earlier if the profits of the manufacturer are more than 9 per cent.; £600,000 in aid of extensions of plant and buildings; and £150,000 in grants in aid of research. It will be remembered that early in 1915 a grant of £1,000,000 was made to one firm at Huddersfield, out of which was created the company known as British Dyes Ltd. This, not unnaturally, created a feeling of dissatisfaction on the part of those dye-making firms which received nothing. The sum mentioned is to be distributed among these firms, besides the substantial amount allocated to the purposes of research. Presumably the £100,000 given for this purpose in 1915 has been spent, but it would be interesting to know how and by whom the money has been used and with what results, in view of the fact that the central research laboratory originally contemplated has never been erected, nor the Technical Committee announced in July, 1915, called into existence.

THE provisions of a law enacted by the Congress of Uraguay require the use of the metric system in all trade transactions. Merchants are forbidden to sell by the piece, package, or for a fixed sum of money, even at the request of the customer, articles susceptible of sale by weight or measure without the use of the metric system. The law provides that when merchandise is sold in sealed packages, tin cans, boxes, bundles, bottles, etc., the net contents or weight must be clearly indicated on the wrappers. In pass books used for sales on credit the weight or quantity of the merchandise sold must be stated, and this must also be done in the case of invoices. Staple articles, such as sugar, maté, kerosene, rice, flour noodles, beans and other dry legumes either ground or in the grain, coffee, tea, salt, liquors, coal and wood in general, meats (including canned meats), lard, fresh vegetables, bread, crackers, milk, fish, cheese, sweet and white potatoes, etc., are required when offered for sale to show prices and weights.

THE autumn lectures of the New York Botanical Garden will be delivered in the Lecture Hall of the Museum Building of the Garden, Bronx Park, on Saturday afternoons, at four o'clock, as follows:

August 31. "Autumn flowers," by Dr. N. L. Britton.

September 7. "Gladioli," by Professor A. C. Beal.

September 14. "Evergreens," by Mr. G. V. Nash.

September 21. "Dahlias," by Dr. M. A. Howe. (Exhibition of Dahlias, September 21 and 22.)

September 28. "Flora of the vicinity of New York," by Mr. Norman Taylor.

October 5. "Autumn coloration," by Dr. A. B. Stout.

October 12. "Cut flowers and how to use them," by Mr. E. I. Farrington.

October 19. "The value of birds in a garden," by Dr. G. Clyde Fisher.

October 26. "Some plant diseases of New York and Virginia," by Dr. E. W. Olive.

November 2. "Plants as insect traps," by Dr. J. H. Barnhart.

UNIVERSITY AND EDUCATIONAL NEWS

A BEQUEST of $5,000 was made to Cornell University by Dr. William M. Polk, dean of the Medical College, who died on June 23. His purpose in making it was to continue the John Metcalf Polk scholarship in medicine.

A FELLOWSHIP in applied chemistry, of the annual value of £200, has been established at Glasgow University by the trustees of the Ferguson Bequest Fund.

PROFESSOR RAYMOND BINFORD, head of the department of zoology at Earlham College, Indiana, has been elected president of Guilford College, North Carolina.

THE vacancy in the deanship of the medical college of Cornell University has been filled temporarily by the appointment of Walter Lindsay Niles, M.D., 1902, who will act as dean through the summer. Further action will be taken by the trustees in the autumn.

DR. A. J. BIGNEY, on leave from Moores Hill College, has been appointed associate professor of zoology in Syracuse University for the ensuing year. Irving H. Blake, A.M., instructor in Syracuse University has been appointed assistant professor of zoology in the University of Maine.

DR. IVAN E. WALLIN, who was recently advanced to an associate professorship in the school of medicine of Marquette University, has been appointed acting professor and head of the department of anatomy in the University of Colorado school of medicine.

AT Glasgow University Dr. Thomas Walmsley has been appointed lecturer in anatomy, with special reference to embryology. Mr. A. McL. Watson has been appointed lecturer in physiology, with special reference to histology. Dr. John McL. Thompson has been appointed lecturer in botany, with special reference to plant morphology.

DISCUSSION AND CORRESPONDENCE

THE PREVENTION OF ROPE IN BREAD

DURING the course of an investigation of the physical and chemical properties of bread, which is being carried on by officers of the Sanitary Corps under my direction, our attention has been drawn to ropy bread. The development of rope at present causes a serious loss of wheat and leads to much annoyance and uncertainty in the manufacture of bread.

Quite recently Lieutenant E. J. Cohn has made certain observations which, if they could be made widely known, might greatly aid in controlling the present epidemic. Accordingly I venture to report upon them here.

The familiar practise of adding acid to the dough as a means of checking the development of rope turns out to depend upon the fact that what seems to be the common cause of the condition, the growth of *B. mesentericus*, can not take place in bread at a greater hydrogen ion concentration than $10^{-5}N$. At the present time the addition of wheat substitutes in bread-making complicates the situation in two ways; first, because such substances commonly produce a less acid bread, and, secondly, because it is more difficult to find out what quantity of acid is desirable on account of the constantly changing conditions.

It is possible, however, to measure the hydrogen ion concentration of bread by the addition of the ordinary solution of methyl red (0.02 per cent. in 60 per cent. alcohol) to the freshly cut surface of the loaf. Three or four drops of the indicator should be placed upon a single spot and five minutes should be allowed to pass. Then, if the color is a full red without an orange nuance, the hydrogen ion concentration is approximately $10^{-5}N$, or more. If an orange tint develops, greater amounts of acid should be added to successive batches of dough until the test with bread just gives the desired color. Our experience seems to show that the growth of rope is inhibited as the hydrogen ion concentration approaches $10^{-5}N$, and that bitter flavor in bread appears only at greater acidities.

Professor Wolbach, of the Harvard Medical

School, has very kindly carried out the bacteriological experiments upon which these results largely depend.

LAWRENCE J. HENDERSON
WOLCOTT GIBBS MEMORIAL LABORATORY,
HARVARD UNIVERSITY

A MICROSCOPIC TRAP

WHILE examining a very rich culture of Protozoa, recently, I saw a living animal caught in the smallest trap that I have ever heard of, about 1/13 mm. in length. The animal was a small Infusorian, apparently *Colpoda cucullus* Mül., as well as could be determined in its cramped position in the trap. The trap was an empty shell of a small species of *Arcella*.

The Infusorian had apparently entered the opening of the empty test and then, after the manner of a fish in a trap, kept swimming around and around the periphery of its prison, thus never coming to the centrally placed opening. I watched it pretty constantly for an hour and a half and it apparently never ceased, for more than a second at a time, its

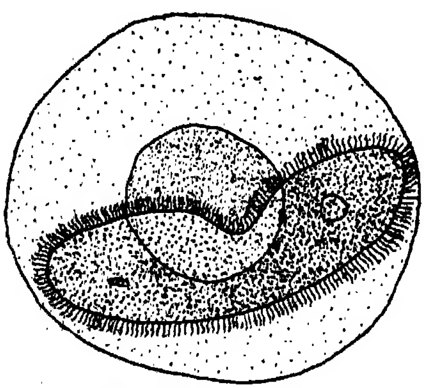


FIG. 1. A small Infusorian trapped in the empty shell of a fresh-water Rhizopod, *Arcella*. Camera lucida; × 630.

forward or backward motion, except that, occasionally, it halted its progressive movement and whirled around rapidly, at a rate of 100 per minute, upon its median transverse axis.

After being under observation for an hour and a half it suddenly became quiet, and, but for the contraction of its vacuole about every 25 seconds, it seemed to be dead. Then it suddenly resumed its swimming and whirling motions, which were continued, with occasional resting periods, till observations ceased at the end of the day, 2½ hours from the first observation.

The slide had been sealed with oil to prevent evaporation of the water, so that the next morning the culture was in good condition, but the prisoner had escaped, during the night, from its trap.

The figure is a camera drawing, showing the animal in the trap, bent to the right, and indented on that side.

ALBERT M. REESE
WEST VIRGINIA UNIVERSITY

A NIGHT RAINBOW

A MOST wonderful display of aurora borealis was visible on Mount Desert Island last night and had the moon not been at first quarter the brilliancy of the display would undoubtedly have been still greater. It had its base on a long, dark, unbroken band abutting on the northern horizon and shot upwards toward the zenith in innumerable streamers of vast reach, lengthening and shortening and shifting like the beams of a gigantic searchlight. Suddenly at about 10:40 P.M. a band like a gray-colored rainbow darted across the heavens near the zenith, passing from northwest to southeast and ending at a point near but not at the horizon. Though it may be common I have never seen the aurora span the heavens in that fashion. It looked like a vast single-span bridge. Beginning west of Arcturus it passed midway between Lyra and Aquila and ended far down in the southeast. At its midpoint overhead it was about as wide as the line joining the three conspicuous stars of Aquila. It seemed to be lower than the firmament, creating the impression of pulling the sky downward and giving a limit to space. Unlike the streamers first seen it did not suggest a searchlight but rather a band of delicate gray veiling, shining, yet not luminous—a night rainbow. It was densest near the zenith but even there the stars were visible through it.

For about thirty minutes little change could

be noticed in it, then it broke up lengthwise and crosswise, moving at the same time still nearer the zenith. A few moments later short parallel streamers began to shoot out from it at right angles and in a northerly direction giving the appearance of the prongs of a crown. Thereafter the long gray bow gradually vanished and in its place appeared irregular small grayish cloud-like masses moving swiftly to and fro across the zenith while short streamers continued to dart upward from the northern horizon.

DAVID RIESMAN

NORTHEAST HARBOR, MAINE,
August 16, 1918

SCIENTIFIC BOOKS

South America. By NELLIE B. ALLEN. New York, Ginn and Company, no date (1918?). Illustrated. 12mo. Pp. xv + 413.

This book seems to be one of a series of "geographical and industrial studies." The author is connected with the state normal school at Fitchburg, Mass., and the book is intended for use of "the children in our schools."

It is a book of good intentions written down to young people; and as young people are in the habit of accepting as the truth all the statements they find in print we feel at liberty to ask whether the children are being properly served. It contains a great deal of the stock information to be found in books of travel, circulars, reports and papers about South America, and mixed in with it are many things that might better have been omitted.

One of the most striking things about it is the air of artificiality and false enthusiasm that the author seems to think it necessary to maintain. It is difficult to keep up such high pressure activities, and, at the same time, to verify statements and to discriminate between trustworthy and untrustworthy authorities. The result is a demoralizing tendency towards exaggeration and sensation. For example, a pile of wheat twenty-five or thirty feet high is called a "mountain of wheat" (pp. 172–3); wheat fields are "a sea of wheat" (p. 171); trains "shoot in and out of tunnels" (p. 127); "cold storage plants are bursting with tons of beef" (p. 162), and maté "becomes as solid as a rock" (p. 197).

Allowances may be made for such evident exaggerations, but unfortunately there are interspersed among them a long list of misleading half-truths, of which the following are examples: Bahia "is guarded by strong forts" (p. 86); "both men and women in Brazil smoke" (p. 86); maté "enables people to do their work and endure hardships without fatigue" (p. 195); "bread (is) made from manioc flour" (p. 201); "Brazil is larger than the United States" (p. 78), and the carriage drive over the crest of the Andes is a "dangerous trip" (p. 225).

Certain other statements are even less than half-truths: speaking of the Amazon region, she says the "forest is always . . . brilliant with flowers" (p. 106); as a matter of fact it is rarely brilliant with flowers. The sandstone reefs of Pernambuco and the coast are called "the great coral reef," and the "coral seawall" (pp. 82–83). It is said that petroleum has been discovered in Brazil (p. 89) (it has not); that "rich beds of . . . platinum are known to exist" in Brazil (p. 89) (they are not); and, among other things, "*pearls . . . are mined in various parts of the country*" (p. 89)!

A writer who makes such haphazard statements can hardly be expected to discriminate in regard to information of any kind. Thus we are told that Paraná means "in the Indian language, 'mother of the sea'" (p. 145); Dr. Theodoro Sampaio, an authority on the Tupi, says it means "like the sea" or "as big as the sea." At page 103 it is said that the wet season in the Amazon valley is from November to February; Carvalho's "Météorologie du Brésil," pp. 205 and 216, says it is January to May at Pará, December to June at Obidos, and January to May on the Negro.

The palm nuts used to smoke rubber in the Amazon region are spoken of as "the fuel he (the rubber cutter) likes best" (p. 119). It is not a matter of what he likes, but a demand of trade. From the beginning of the rubber industry to the present the rubber gatherers of the Amazon region have considered it nec-

essary to use for rubber smoking the nuts of the Urucury palm, botanically known at *Attalea excelsa*.[1]

Of Rio de Janeiro it is said that a person who visited that city twenty-five years ago would hardly recognize the city to-day, and that "the traveler who was so unfortunate as to be obliged to stop there held to his nose a handkerchief saturated with disinfectant as he made his way through narrow, dirty, undrained streets" (p. 93). Such statements may make an effective background for references to the present healthfulness of that city, nevertheless, they are gross exaggerations. The statement (p. 93) that the people of Rio "learned from the United States how to make the city a pleasant healthful place to live in" is misleading to say the least. The fact that malaria was transmitted by mosquitoes was discovered by a surgeon in the British army. And as for Rio's beautiful Beiramar, we regret to say that there is no such a water front drive in the whole United States from which it could have been copied.

Both maps and text keep up the ancient myth about the forests of the Amazon valley being called *selvas* (pp. 105, 125). As a matter of fact they are called *mattas* by the people, and the forest map of Brazil by Dr. Gonzaga de Campos calls them *mattas*. But why must a foreign word be used at all? They are simply tropical forests.

But errors of statement that may be matters of oversight are of less importance than the attitude of teachers who think it necessary to use extravagant language in order to awaken the interest and to hold the attention of pupils. At page 123 we are informed that Indians have gathered the rubber, the sailors have manned the ships, and the workmen in the factories "have spent their time *in order that you may be protected from the wet.*" There is not a workman in that list who doesn't know better. And when attention flags, something more startling than usual must be injected into it. "Did you hear that loud report? Look at the column of smoke rising in the field over to the right" (p. 267). It turns out to be nothing more serious than the workmen blasting out the rocks in the nitrate fields. And though the nitrate regions of Chile are in low hills along the western margin of a flat ancient lake bed she says the "surface of the country is all upheaved" (p. 266), and gives a picture of waste rock from the quarries as evidence of the upheaval. Fictitious resemblances between the United States and Brazil are discovered (p. 78); while "Lying in its wide mouth, as the prey might lie in the open jaws of a great serpent, is the island of Marajo" (p. 104).

[1] Wallace's "Palm Trees of the Amazon," p. 118.

Some of this writing down to students is harmless enough, but one wonders why it is necessary to use a platitude instead of plain English; for example, coffee is called "our morning cup," and she "explores" the streets of Buenos Aires (p. 164). All of which is in keeping with certain other hackneyed expressions, such as: Bahia bay is "large enough to hold all the navies of the world" (p. 86); "every part of the animal, except the bleat and the bellow, is made use of" by the meat packers (p. 181). The pity of it all is that when the author forgets these antics and sticks to facts and to plain English she is an interesting writer, a fact which leads one to conclude that it is the system that is at fault rather than the author of the book.

There are legitimate ways to hold the attention of students, and there is a reasonable mean between buffoonery and the dry-as-dust way of presenting instruction. The idea that studies must be made entertaining has so penetrated our schools, our teachers, and our text-books, that the seriousness of education is well nigh lost sight of in the sensationalism, extravagance, and unwholesome lack of sincerity that naturally springs from such false conceptions.

JOHN C. BRANNER

STANFORD UNIVERSITY,
CALIFORNIA

PATENT REFORM PROSPECTS

THE following letter is published for the information and suggestions it contains:

Patent Office, Washington, D. C.,
July 29, 1917.

Mr. F. F. Withrow, and Others,
Patent Office, Dept. of Agriculture,
Ottawa, Canada.

Gentlemen: Below is submitted a general response to your valued letter of inquiry dated July 4, 1918. You may find it largely an extenuation of present comparative inaction.

The first definite steps toward the founding of our society were, in point of fact, taken by a group of assistant examiners more than a year since. Hon. Thos. Ewing, at that time commissioner of patents, lent some countenance to the movement, after ascertaining the favorable majority sentiment of the corps. The society and its work are still too undeveloped to justify much retrospect, but it is a matter of special gratification here that the membership has now been extended to include not only all chiefs of examining divisions, and the vast majority of assistant examiners, but also all chiefs of other divisions and all higher officials—thus including the present commissioner, Hon. J. T. Newton, First Assistant Commissioner Whitehead, and Assistant Commissioner Clay—whose paper reproduced in the *Scientific American Supplement* for January 9, 1918, is enclosed herewith.

Provision is made for associate membership on the part of those not members of the examining corps, the present fee being one dollar per annum; also for honorary membership, without fee. No honorary members have yet been elected.

The general objects of the society are perhaps best epitomized in the phrase "Devoted to the Improvement of the Patent System," which its stationery now bears. The society is of course interested in the promoting of mutual acquaintance within the office and with those who have business before it; in the elevating of standards of practise, information and efficiency; in the improvement of working conditions, methods and equipment; in better opportunities and incentives; in better organization and informative resources; and (by no means least) in meeting more than half way efforts toward patent reform on the part of any and all who may appreciate the predicament of the office and the possibilities and public importance of better patents and greater security therein.

In conformity with a resolution adopted by the Patent Office Society and fully concurred in by Commissioner Ewing while in office, the National Research Council, with expanding offices now at 1025 16th St. in this city, appointed, in 1917, a committee for the preliminary study of Patent Office problems. Under the chairmanship of Dr. Wm. F. Durand (now in France), several meetings of this committee were held, at two of which there were presented discussions arranged for by a special committee of the Patent Office Society—although responsibility for views expressed was, of course, entirely personal. The first paper presented as referred to was that of Mr. M. H. Coulston, at that time a law examiner (now chief clerk, and also president of our society), and it related to patent appeals. That paper, with slight changes by its author, our committee in charge of the forthcoming *Journal of the Patent Office Society* has decided to print in an early issue—moved thereto perhaps equally by the spirit in which it was prepared, by a subordinate in the "system," and by the intrinsic importance of its topic. Other discussions presented at the meetings referred to were as follows:

Procedure and conclusions of the President's Commission on Economy and Efficiency in their investigation of the Patent Office in 1914;
Needed legislation relating to assignments, or to the work of the assignment divisions;
The needs of the Patent Office library;
Suggested changes in the interference practise;
Proper soliciting and adequate searches;
The improvement of patent claims;
The need of a secondary classification of patents, based on industrial arts;
The essentials of a proper Patent Office building;
Incentives and opportunities within the Patent Office;
A proposed reorganization of the examining corps.

The mentioned committee of the N. R. C. (whose complete original membership, comprising some of the most noted of American scientists, engineers, inventors and authorities in patent law, was published in Science for December 26, 1917), is understood to have convened more recently at the New York offices of Mr. E. J. Prindle, the present chairman being Dr. L. H. Baekeland, of Yonkers, N. Y. Early enlargement of the committee was anticipated, and an additional committee of prominent engineers has in fact been appointed, under the chairmanship of Chas. A. Terry, E.E., by the United Engineering Societies, the last-named committee having authority to cooperate with the N. R. C., and others, in patent reform efforts.

As a consequence of the receipt of such information as the foregoing, and notwithstanding the fact that military and naval problems of the utmost urgency do seem to have foreclosed a first mortgage upon the *present* attention of all those men upon whom successful patent reform must depend, the "small beginnings" mentioned are still believed here to afford some promise of real prog-

ress; *c'est le premier pas qui coute!* And in this connection attention may be called to a heartening Executive Order of President Wilson's, dated May 11, 1918, which includes the following:

The National Research Council was organized in 1916 at the request of the President by the National Academy of Sciences, under its congressional charter, as a measure of national preparedness. The work accomplished by the council in organizing research and in securing cooperation of military and civilian agencies in the solution of military problems demonstrates its capacity for larger service. The National Academy of Sciences is therefore requested to perpetuate the National Research Council, the duties of which shall be as follows:

In general, to stimulate research in mathematical, physical and biological sciences, and in the application of these sciences to engineering, agriculture, medicine and other useful arts. . . .

To survey the larger possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects.

To promote cooperation in research, at home and abroad, in order to secure concentration of effort, minimize duplication, and stimulate progress; but in all cooperative undertakings to give encouragement to individual initiative, as fundamentally important to the advancement of science. . . .

The international character thus given to the National Research Council as a public, permanent institution will not escape notice. Are we not justified in feeling that we have hitched our wagon to the proper star? At any rate, obliged to live on corn meal and confidence, some of us especially value the latter!

The movement toward a Washington location for that great International Institute for the history of science proposed by Dr. George Sarton and others (and coveted as an associate by the Patent Office) also appears here to await a more favorable moment for public attention—although the resolutions upon this subject adopted by the Patent Office Society have already been strongly seconded by the Washington Academy of Sciences, and the American Society of Civil Engineers, as well as by several of the powerful scientific bodies local to this city. At a suitable moment, this project may be again pressed, although leadership therein is understood to devolve upon Dr. Sarton. . . .

How intrinsically absurd must appear the complete duplication, within each nation, of all those facilities and technical qualifications prerequisite to the proper determination of such purely *research* questions as operativeness, and novelty of conception! Surely the possible economy in search-costs alone must appeal more and more strongly not only to the inventors, who pay these particular bills, but to that increasing multitude now fortunately interested in the proposals looking toward a league of nations—or, at least, of democratic states! How much better the work of both could be done if the Canadian Patent Office and that of the United States could be coordinated at once, with united resources of men and means!

Salary resolutions, calling attention to the fact (ascertained by a questionnaire sanctioned by Commissioner Newton) that the great numbers of men annually leaving the office commonly double their incomes within three years; to the lack of satisfactory recruits, or of means for retaining properly qualified men; to the rapid consequent rate of resignation even for non-military employment; and to the corresponding jeopardy of inventor's rights entrusted to unqualified and inexperienced men, were duly approved by the executive committee of the Patent Office Society, but have been withheld from publicity—apparently because of misgivings lest shouting while cannon roar may be misunderstood—if it happens to be noticed at all!

Meager as they are, the assets of the society have proved sufficient to enable it—meeting as it does in the Patent Office Building—to purchase a projection apparatus adapted for motion pictures, of which notable use has already been made in showing the development and practise of particular arts; and also to tempt it, under the active leadership of President Coulston, into an essay at the publication of the mentioned *Journal*. For the first year, the price of this is fixed at $2.50, and its columns are intended to contain not only expositions of the present somewhat complicated practise, but also material deemed to deserve further consideration whenever the day for real patent reform shall dawn. These activities, for which some manuscripts are already at hand, may, of course, pave the way to a still wider field of usefulness: for in scientific and technical fields, as well as in legal, the possibility of suitable publication of historical studies must, of course, be accounted a legitimate incentive to study.

Possibly indeed any society centering in a government office must consider itself limited forever to an opportunist policy, making real advances, other than those of self improvement, only when the breath of a very genuine and generous official approval—undisturbed by the anxieties of a period of war—shall accord, during some constructive period, with a current of awakened public interest. Yet it is not without confidence that our society

now hoists its modest banner, believing that the administration of Secretary Lane under President Wilson affords a peculiarly favorable moment for the initiation of cooperative efforts of which the justification may be rational, rather than merely traditional. Obviously, those patent reform efforts which the National Research Council is understood to have deferred (in so far as they have been deferred) only by unavoidable necessity can reach the largest effects only as a result of a very comprehensive movement—in regard to which all interested and competent parties should be heard. And (if every other special qualification be disputed) who so well as examiners and assistant examiners can tell how distressing a thing it is for men charged with exhaustive research, and with judicial responsibilities therein, to be obliged to act hastily and superficially upon matters involving the largest public and private interests?

Lightly tossing a very broad challenge, one might ask—"Do not the prospects of democratic government, in competition with more centralized forms, ultimately depend on the capacity to initiate, to organize, to present and to utilize criticism. Within a republic, does not the duty of utterance devolve upon all who possess special information? But we now press only the more specific question: Is it not reasonably possible that manufacturers, investors, practitioners, jurists, publicists, scientists and engineers, as well as inventors of every field and grade, conferring under the coordinating influence of so disinterested and competent a body as the National Research Council, will, from this time forward, work more and more effectively to insure the *prompt* grant of *proper* patents—only; and to make the genuine inventor, the investor and the public alike really *secure* by a very clear and a very just definition of rights? Upon the determination of this one fundamental question we do urge an early test—before still more complete failure of the patent system shall bring it into utter contempt—even though in the execution of such a test we, the "proponents," may be able to undertake only a very subordinate part.

At least, we of the Patent Office Society hope we simplify the situation by inviting—for possible publication, and by no means in a spirit of challenge—criticism of any phase or feature of the present patent system. May we not soon hear again from yourselves?

Sincerely and fraternally,

BERT RUSSELL,
Secretary, Patent Office Society

SPECIAL ARTICLES

POLARIZATION IN CASE OF MOVING ELECTRODES

IN connection with other work, I incidentally came upon the following phenomenon which I have not found clearly stated anywhere; though from the enormous amount of work done on polarization, I can hardly suppose it to be new. In part it might be surmised from Hittorf's researches on the migrations of the ions.

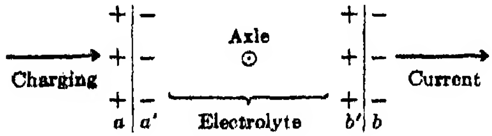
In order to keep the resistance of the circuit constant, bright zinc electrodes, facing each other diametrically, and set tangentially to the arc of motion, were rotated around a vertical axis midway between, in an electrolyte of dilute brine. A small electromotor and pulleys, collector rings and brushes made up the remainder of the apparatus. Special care was taken that all parts of the circuit, except the free zinc surfaces to be tested, were thoroughly insulated; for the effects produced by splashing of liquid may be misleading and the brush contacts must be good.

The electrodes at practically the same potential were now charged by a single storage cell for 30 sec., the charging current being .16 am. for electrodes of about 26 sq. cm. each. On breaking, the polarization was naturally enormous (needle off scale); but it vanished rapidly in the well-known way, being counter to the charging current. When this polarization had fallen to about — 0.010 volt, the electrodes were rotated. At once the polarization changed sign and was again enormous (needle off scale) and in its turn fell off in the usual way. When it had fallen to + 0.004 volt the electrodes were stopped, leaving + 0.003 volt, about.[1] Subsequent motion increased the electromotive force slightly in the direction of the charging current. In other words this second or residual polarization observed during the motion of the electrodes is astonishingly strong and *in the direction of the charging current*. To test this further, the latter was reversed many times, always reversing the phenomena as a whole, while in character they remained the

[1] Different experiments give different data, without changing the character of the values.

same. The electrodes must be bright, as otherwise the phenomenon becomes very complicated. Furthermore the *original* polarization must often surpass a certain value if the residual polarization is to be contrary in sign; and there are other differences in detail for which there is no room here. Thus the rotational effect may proceed gradually to a maximum; an electromotive force zero may imply a very large residual polarization appearing on motion. The charging of moving electrodes is an interesting case; etc.

To elucidate this phenomenon, it suffices here to assume the occurrence of paired double layers *a a'* and *b' b*, one double layer at each electrode. One element, *a'*, *b'*, of each double layer is localized in the liquid and the other element *a*, *b* in the solid electrode, both of the double layers having the same direction; *i. e.*, being two condensers in series. Hence there are two interpenetrating electrostatic fields, one



b' a' localized in the liquid and the other *a b* in the electrodes. These fields are in a contrary direction and the liquid field must be very much stronger to correspond with the initial counter polarization. On rotating the electrodes, the field localized in the liquid *b' a'* is set free and its ions dissipated. The field localized in the solid, *a b*, however, remains and this constitutes the residual polarization in the direction of the charging current. Both fields decay in the lapse of time in the usual way.

When rotation ceases a liquid field is reestablished, but usually, though not always, to a smaller degree. Eventually *a* probably discharges *a'* and *b*, *b'*, one of the fields passing through zero first, so that the effect of rotation finally vanishes. I have met both with marked polarization which on rotation vanished, as well as with an apparent absence of polarization which on rotation became very marked.

To obtain moving electrodes as free from polarization disturbances at the contact with a liquid, it is therefore prudent to capture both fields; *i. e.*, to leave the electrodes entirely without interferences. This may be done by surrounding each with a porous cup, closed and completely filled with an electrolyte, the terminals passing out through an insulating tube. The electrodes should moreover be fixed rigidly to the cup. Again since zinc electrodes soon tarnish in brine but remain bright in concentrated zinc sulphate solution, the latter is a preferable electrolyte and the cups may be submerged in brine or any other solution.

I therefore constructed two cup electrodes of the kind in question and placed them in the rotational apparatus as before. The original potential difference of the zincs was about .4 millivolt. After keeping the circuit closed over night this fell off to below .05 millivolt, and could be eliminated by exchanging the cup electrodes. Rotation of the appartus, *i. e.*, an external current in the brine surrounding the cups, produced no appreciable effect. The electrodes were then charged with a current of .2 am. for 30 sec. The polarization remaining was now much less than above, throughout, beginning with about 5 millivolts which fell to .5 m.v. in 5 minutes and to .05 in a few hours. Rotation was ineffective through all stages of the decay. No doubt the simple electrode in which both the original and the residual polarizations have vanished would often suffice, but with greater uncertainty, because such electrodes can not be exchanged without danger as to modifying their value.

Carl Barus

Brown University,
Providence, R. I.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, SEPTEMBER 13, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

JOHN DUER IRVING

JUST at the close of last July, not only personal friends, but geologists in general in America were shocked and grieved to learn of the death of Captain John Duer Irving of the 11th U. S. Engineers, professor of economic geology in the Sheffield Scientific School of Yale University, on leave. Alike as active and productive geologist, as successful and devoted teacher, and as managing editor of the magazine *Economic Geology* from its beginning in 1905, Professor Irving was known and esteemed by a very wide circle. He was born August 18, 1874, in Madison, Wis., where his father Roland Duer Irving was professor of geology in the State University, and was just starting his fruitful investigations in Lake Superior geology. John, the son, lived in Madison until his father's all too early death in 1888. Mrs. Irving removed to the east and John was prepared for Columbia College, which he entered in 1892, representing the fourth generation of his family in the direct line, to be registered on the college rolls. He graduated in 1896 and took his doctor's degree in 1899.

Beginning in the vacation following his junior year, he had field experience each summer, and worked successively in the Uinta Mountains of Utah; the Adirondacks in New York; the San Juan region of Colorado; and in the Black Hills of South Dakota. Partly from the example of his father and partly from the writer's influence, economic geology became the branch which he specially followed. On taking his Ph.D. Dr. Irving joined the U. S. Geological Survey, and was assigned to a party in the Black Hills, and in time under the oversight of S. F. Emmons completed the professional paper on the ore deposits of the northern hills. His association led to his becoming in later years Dr. Emmons' closest associate in the revision of the famous Lead-

ville monograph. The close and confidential relation with Dr. Emmons, who was one of the most careful and accurate of American geologists, as well as one of the best of men, was extremely influential upon the younger man. Irving also had experience while connected with the U. S. Geological Survey in the Globe district of Arizona; at Park City, Utah; in the Needle Mountains and at Lake City, Colorado; and in the coal regions of Indiana and Pennsylvania. In his later years he visited the western states and Alaska on mine examinations and in connection with apex litigation.

His first teaching experience came in 1903, when he substituted for Professor Wilbur C. Knight for a year at the University of Wyoming. He was called to Lehigh University in 1904, and to the Sheffield Scientific School of Yale in 1907. His work as editor began in 1905 when the magazine *Economic Geology* was established and he was the choice of its directors for managing editor.

Professor Irving has left a very creditable series of papers, which were issued during his connection with the U. S. Geological Survey. His work is marked by accuracy and patient care. He was not only a good observer, but possessed abilities of description and inference of a high order. In this group of his contributions the most elaborate will be the revised monograph on Leadville. While the fundamental observations and data were accumulated under Dr. S. F. Emmons' oversight and in no small degree by him personally, Dr. Emmons died when he had only prepared a few pages of introductory manuscript and the main work of composition was completed by Professor Irving and was done with scrupulous and almost filial devotion.

As editor of *Economic Geology* Dr. Irving was tireless and persevering. In large degree his efforts to secure papers brought to its pages the long list of striking and timely contributions with which they are crowded. He obtained thereby a wide and intimate acquaintance with topics of interest. He himself made especially thoughtful and suggestive contributions on the criteria for identifying replacement-deposits; on the causes which localize ore-shoots; and on the importance of having the same observer study large problems in many localities, rather than work out the details and teachings of a single district.

Dr. Irving had a fine sense of clear and finished literary expression, as might justly have been expected of one whose direct forbear was Washington Irving's brother; and whose father's work was marked by the same characteristics. In disposition he was considerate, kindly and affectionate, such that he was greatly endeared to his friends.

When German ambitions and hostility in the spring of 1916 began to threaten the United States with the grim possibility of war, Professor Irving went to the officers' training camp at Plattsburg. Being unmarried he felt it his duty to fit himself for service and at the close of the training period handed in his name as available if needed. In the spring of 1917 he was called and passed his examinations for a captaincy. He was commissioned in the 11th U. S. Engineers, "the fighting Engineers" as they have been known since Cambrai. He sailed for France in July, 1917, and had been building railroads and giving instruction to young officers in mining engineering as long and continuously as he was able. His strength became overtaxed, and when an attack of Spanish grippe developed into pneumonia, he could not resist it. He passed away July 20, in Flanders, and his name was entered on the Roll of Honor.

James F. Kemp

RACE-APPRECIATION IN LATIN AMERICA

Anthropologists, in their elaborate, careful and invaluable researches into the past history of the native race of the American continent, have been wont to devote the major part of their space to the *former* cultural attainments of that race. They ignore the fact that, in Mexico, in some of the Central American countries, in Colombia, and in the Andean countries (Ecuador, Peru and Bolivia), that race is to-day anywhere from sixty-five to eighty-five per cent. of the total population.

Of course the degree of racial purity varies considerably, but this high percentage includes all those who have an obvious and undeniable admixture of indigenous blood. For this reason it is exceedingly important that anthropologists, who are already well informed as to the *past* of these people, should, for the sake of our continent as a whole, set themselves to learn about their *present* status.

A beginning of this necessary study has already been made. In Mexico, the well-known archeologist, Manuel Gamio, is now the head of a branch of the Secretaria de Fomento which has as its purpose the collection of data relating to the present numbers, cultural and economic condition of the Indians, and to the steps that should be taken to insure their highest development, not only on their own account, but for the sake of the benefits that will accrue to the state from such a policy. The work of Gamio's Dirección de estudios arqueológicos y etnográficos has already been sketched by him in a recently published book.[1] It is quite clear to any one who reads this remarkable little book with due care that the fundamental trouble with Mexico is not, as most of us North Americans are wont to think, some inherent wickedness and turbulence on the part of the Mexicans, but that it arises from the maladjustment of Mexico's political institutions to her racial and psychological temperament. It is Gamio's purpose to change this condition so as to make available to Mexico the great store of strength and virtue which lies hidden in the hitherto misunderstood and despised Indian element. To do this drastic reforms in the educational, agrarian and economic institutions of the country will doubtless be necessary. Time and study will reveal just what is needed.

A situation very similar to that in Mexico exists in many other Latin American countries, as I have said. It has been my especial good fortune to study this matter in Peru and Bolivia. Because of my first-hand knowledge of the importance of race-appreciation in those countries I may speak about it fully, for it is an important matter. Before proceeding further, I would better define the term I have used. Race-appreciation is the study of those cultural elements which survive from the formerly independent cultural state of the Indians (or any similarly subjected race) into our own day. It seeks to blend all that is best in them with all that is best in white culture so that the dual population of such countries shall have institutions based upon those of both component races.

The matter of race-appreciation in the Andean countries is of the highest importance for their future development. On the coast the present situation of the Indians is not by any means of the worst. Many of their own social and governmental institutions survive, which makes for contentment on their part and for a firm but kindly control by the whites of the upper class. As elsewhere in the Andes, the land almost all belongs to very large landed estates. The owners of these, for the most part, differ from their Mexican counterparts in not being oppressive and unjust. I have known a great many people of this class in different parts of Peru, and I can say frankly that not only are they progressive and eager to better the conditions of their native tenants but also that the Indians esteem and like them. Nevertheless, a process of reform, especially with regard to sanitary conditions, housing, clothing, pastimes and working-places, would be of inestimable value, especially if it were so conducted as to take over the native administrative system (based on families, clans and tribes) and made use, at the same time, of the special skill of these people in such matters as weaving, irrigating and building.

To reduce the matter to concrete terms I will speak of each one of these three aptitudes in terms of what might be done to make them useful to modern society. In the first place, I will venture to remind the reader that in pre-Columbian times the people of the Peruvian coast made the finest cotton and woollen

[1] Gamio, Manuel, "Forjando Patria," Mexico, 1916. Should any one who reads this article care to have a copy of Mr. Gamio's work (which is in Spanish), I shall be glad to supply him with a copy gratis so long as the very few which I have hold out. My address is given below.

textiles that have ever been made. Not only were they strong and durable, as well as of fine texture, but they were also exquisitely dyed with tasteful designs. Some of them were wonderfully embroidered; still others had striking patterns painted upon them. To-day the cotton raised on the Peruvian coast is rapidly getting to be the best grown anywhere. The supply of llama and alpaca wool might soon be vastly improved if care were devoted to the matter. Furthermore, there is no reason why, after necessary experiments as to methods had been made, the two other great fabric materials of the world (linen and silk) should not be grown in Peru. With plenty of raw material at hand, why could not steps be taken to make use of the weaving ability which to-day is remarkably strong in the coast Indians? Of course, to put such an enterprise on a modern and economically productive basis weaving machinery would have to be used. But that would prove no drawback, as far as the people themselves are concerned. They are very intelligent, and they take quickly to mechanical contrivances, as is proved by the success with which Indians are used in cotton gins, sugar mills and similar places. Perhaps it would be best to work out some variety of loom half-way between their hand-looms and our North American type. This might result in giving greater play to their natural genius for weaving.

In the matter of irrigating the Indians long ago proved themselves adepts. Steps should be taken to encourage them to re-irrigate those parts of the country in which the old irrigating canals were destroyed by the Spaniards. To encourage this, the owners of the land could hold out special rewards to enterprising Indians, such as practical freehold (long lease or a percentage in the profits). The whites have not the aptitude in this direction that the Indians have. White engineers, in their eagerness to plan and build enormous hydraulic works that would cost millions, lose sight entirely of the tremendous amount of work that once was and could again be done in a small way, by building slowly a little at a time. In many cases, the engineering problems involved, especially those which concern the restoration to use of ancient irrigation canals, are not of great difficulty, and more could be done along the piecemeal, bit by bit line than by elaborate dams and prohibitively expensive pumping works.

In the matter of architecture, the ancient pottery of the coast people shows us that the people used to build houses which were not only tasteful and picturesque but were airy and cool as well. They had gabled roofs, made of thick thatch, and thick walls of adobe. There were windows of various odd and quaint shapes, as well as doors. When one compares these admirable structures to the wretched flimsy huts made of cornstalks and old tin cans daubed over with mud which serve the people to-day, he sees how much better was their old condition. If the ancient skill of these people in making fine and durable adobe could be turned to the manufacture of the still better concrete, and if the systematic use of good houses designed after those anciently used could be introduced, the living conditions, health, productiveness and vigor of the people would mount rapidly.

In all these directions, as well as in others which lack of space forbids me to mention, there is imperative need of a judicious adaptation to modern needs of the inherent abilities of the people.

In the highlands, the situation is far less satisfactory. The climate is cold and depressing. There is a general lack of fuel for warming the houses and for warming water for bathing purposes. In addition, there is the necessity of constant and very heavy labor if any but the most meager crops are to raised. Alcoholism is a pronounced evil in the highlands. As a result of all these sadly adverse circumstances, the people are doltish, filthy and depraved, not only the Indians but also some of the whites. It is for the more felicitously situated and enlightened elements of the population to do what they can, especially by rigidly enforcing the laws to curb alcoholism, to ameliorate these conditions. Race-appreciation here, as on the coast, must play an important part, for today almost nothing is

being done to study the Indians and their peculiar abilities in weaving, handicrafts, masonwork, irrigation and other directions for the sake of adapting them to modern requirements. For one thing, I believe that the Andean countries are capable of becoming leaders in the production of cattle and sheep. The present stock, however, requires to be improved by new blood. Then too, the native wool-yielding animals, the llama, alpaca and vicuña, should be studied and taken care of. For all this the highland Indians supply the necessary labor element. If shaken loose from their alcoholism and their resultant depraved ways, and if given decent living conditions, they would rapidly become fine sturdy peasants equal in capacity and intelligence to the peasants of Switzerland. So many travelers and superficial observers who have not lived among these people or who have not observed them with sympathetic eyes have told the world that their condition is hopeless that many people now believe it is so. I am sure, however, that, given proper aid now, the Indian mountaineers could be lifted into the state which I have mentioned.

To conclude I will present several reasons for the necessity of anthropologists' doing what they can to aid in race-appreciation, especially as regards the countries under consideration.

1. The indigenous element, more or less pure, forms so large a part of the entire population that it is positively dangerous not to develop to the utmost all its latent capabilities. If this is not done these countries will find themselves weighed down with an enormous element which is not merely economically underproductive, but which is really vicious and seditious, productive of all manner of social evils, the result of four centuries of bad treatment by white men.

2. If race-appreciation is seriously instituted, the countries where it takes effect will find that their commercial output will increase rapidly on account of the increased mental and physical vitality of the great majority of the people. The population will not only grow fast because of the cutting down of the death-rate, but those who live will work better and will be stronger and happier than their forebears of the days since the Conquest.

3. If steps are taken by the various owners of large landed estates in the Latin American countries under consideration to learn about the Indian or labor element of their tenantry, either from professional anthropologists and ethnologists or from their own observations, and if they will seriously undertake the reforms that may be found necessary, the result may be that salutary one of showing the world that it is possible for distinct classes to work together in harmony and without constant irritation and recriminations.

4. On account of natural conditions involved in the climate and geography of the countries under discussion European immigration on a large scale will never take place. Indeed, there is a general apprehension in those parts that the small supply of mechanics and other specialists who hitherto have come from Europe and North America will, on account of war- and post-war conditions, presently cease to be available. It is obvious, therefore, that if those countries wish to progress according to modern standards they will either have to try the rather perilous experiment of importing large numbers of Orientals and Pacific Islanders, or they will have to take immediate steps toward bringing their present population to as high a level of development as possible. This can only be done in accordance with the principles of race-appreciation. It should be done soon.

Although I have been speaking of America especially, I wish to remark before concluding this brief sketch that race-appreciation may be said to be needed in every country where the white race has imposed its dominion upon some other race with a more or less vigorous cultural character of its own. The British, in India, Burmah and other colonies of theirs have been, half unconsciously, following these principles for decades. That explains their success. The same may be said of the French in Annam, Morocco and Algeria. It is ob-

vious that no other policy than that based upon race-appreciation is either just or stable.

Philip Ainsworth Means
196 Beacon Street,
Boston, Mass.

THE AMERICAN SYSTEM OF AGRICULTURAL EDUCATION AND RESEARCH AND ITS ROLE IN HELPING TO WIN THE WAR[1]

The United States has, in its Federal Department of Agriculture and state (land-grant) colleges of agriculture, a system of agricultural research and education which was established more than 50 years ago and which reaches every part of the country and effectively deals with every phase of agriculture. It is worth noting that the national foundations of these two great agencies for the betterment of agriculture were laid in another period of great national stress.

The act of Congress creating the Federal Department of Agriculture was signed by Abraham Lincoln on May 15, 1862, while the Civil War was in progress. On July 2 of the same year he approved the so-called land-grant, or Morrill, act, giving the proceeds from the sale of certain allotments of the public land to each state and territory for "the endowment, support, and maintenance of at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts . . . in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life."

The national system of agriculture, education and research thus established has been greatly developed by subsequent legislation, notably the acts providing for agricultural experiment stations in each state and for cooperative extension work in agriculture and home economics. Many other important and highly significant laws for the betterment of rural life have been placed on the statute books within the past few years, including especially the cotton-futures act, the United States grain-standards act, the Federal warehouse act, and the Federal aid road act. All these measures are administered by the Department of Agriculture and they are achieving, in marked degree, the purposes contemplated by their framers. The federal reserve act, the farm-loan act, and the federal vocational education act also constitute an important part of the legislative program for the improvement of rural conditions and the development of agriculture. Thus the nation was well prepared along agricultural lines to deal promptly and effectively with the emergency problems that have arisen since the United States entered the war. It is not extravagant to say that this nation had agencies working for the betterment of rural life and agriculture which, in point of personnel and effectiveness, exceed those of any other three nation in the world combined.

The land-grant colleges and experiment stations are without parallel. They are 67 in number, have a total valuation of endowment, plant, and equipment of $195,000,000; an income of more than $45,000,000, with 5,900 teachers; a resident student body of over 75,000, and a vast number receiving extension instruction. Their great ally, the Department of Agriculture, is unquestionably the greatest practical and scientific agricultural organization in the world. It has a staff of more than 20,000 people, many of them highly trained experts, and a budget of approximately $65,000,000.

The graduate and collegiate instruction and the research work inaugurated by these agencies take rank with the best in the world. As the result, a large corps of leaders and specialists, capable of dealing efficiently not only with the vital question of agricultural production, but also with important war problems not directly connected with agriculture, has been trained. Through the educational work of the colleges a great impulse has been given to vocational training in agriculture and through the research work of the Federal Department and the experiment stations a great

[1] *Weekly News Letter*, Department of Agriculture.

body of new facts of value to agriculture has been accumulated, which the extension service carries directly to the farm and farm home.

The extension, or demonstration, method of teaching and inducing farm people to adopt improved practises is a distinctly American educational development. It was first used in a systematic way in 1903 by the late Dr. Seaman A. Knapp in his efforts to teach southern farmers how to meet the menace of the boll weevil. This method of giving practical instruction in agriculture and home economics to persons not attending or resident in colleges by means of demonstration, that is, by doing on the farm or in the home, or better, by having the farmer, or the housewife, or their children do the thing it is desired to teach, has been developed by the United States Department of Agriculture and the state colleges of agriculture during the past fifteen years. It was made a permanent and nationwide system and liberally endowed by the cooperative extension act of May 8, 1914, which provided that all such work should be coordinated and carried on cooperatively by the state colleges of agriculture and the Federal Department of Agriculture.

The department exercises administrative and general supervisory control of this work through its States Relations Service. It is administered in each state through a director of extension with headquarters at the state college of agriculture, in accordance with plans agreed upon by the Federal Department and the state colleges. The field work is done by (1) men county agents, (2) women county or home demonstration agents, (3) boys' and girls' clubs, and (4) a corps of specialists furnished by the Department and the state colleges. Through these agencies it reaches at first hand and in a very practical way the men, women and children of each rural community.

The cooperative extension act will ultimately (in 1922–23 and thereafter) provide $4,580,000 annually for this work, to which the states must add $4,100,000 annually in order to share in the benefits of the act. During the fiscal year 1917–18 there was available for extension work from these sources $3,680,000. Funds from other sources increased this amount to $7,600,000. In addition, $4,348,000 of the special appropriation made to the Department of Agriculture last year for the stimulation of agriculture was devoted to the expansion of the extension work as a war-emergency measure.

That the nation entered the war with well-organized and highly efficient agencies working for the betterment of agriculture is well illustrated by the part they have played in dealing with food problems during the present emergency. In April, 1917, the food situation of the nation was not satisfactory. The time for action was short. It was necessary that nothing be omitted to increase the supply of food, feed, live stock and clothing, and to grow strong in agriculture, while Europe, and especially the central powers, was growing weak. The machinery was ready. The farmers and their organizations were alert. The department and its great allies, the land-grant colleges, immediately proceeded to redirect their activities and to put forth all their energies in the most promising directions. In a conference of the agricultural leaders of the nation in St. Louis, called just before the United States entered the war, a program for further organization, legislation and action with reference to production, conservation and marketing was drawn up, the principal features of which have been enacted into law without substantial change or have been put into effect. This prompt and effective handling of the situation was made possible by reason of the fact that the American people, generations before, had wisely laid the foundations of many agricultural institutions and had with increasing liberality supported their agricultural agencies.

In due course the Congress enacted the food-control bill, conceived at this conference, now administered by the Food Administration, and the emergency food-production act, administered by the Department of Agriculture. With funds made available by the latter act, the department increased its activities along all essential lines and developed new ones. It

and the state colleges cooperating with it quickly took steps to expand the extension work, with a view to placing in each rural county one or more agents. Within a year the number of county and home demonstration agents, club leaders and specialists in various lines employed in the great extension system was more than doubled, thus putting into effect within a year a program of expansion which under ordinary conditions would have required many years to complete.

The number of men county agents has been increased from 1,434 to 2,435 within the year, the women home demonstration agents from 537 to 1,715, and similar increases were made in the personnel of the boys' and girls' club work. To-day there are employed in this great educational system over 6,000 county and home demonstration agents, club leaders, and specialists in various lines, and the extension work is organized in substantially every agriculturally important county in the country. These agents are not only aiding the farmers in agricultural problems, but they are also rendering valuable assistance to other branches of the government, such as the Treasury Department, the Food Administration, and the Red Cross, in the prosecution of their war activities.

The efforts and achievements of the millions of farm men and women of America have been noble and remarkable. The farmers have occupied the first-line trenches of the food army. They and the agencies assisting them, the Federal Department, the state colleges, and also the state departments of agriculture, were ready when a state of war was declared and had been for years. They were charged with the responsibility for maintaining and increasing production. How they have discharged their task the results of last year's production operations and of this year eloquently testify. David F. Houston,

Secretary of Agriculture

SCIENTIFIC EVENTS

TRENCH FEVER AND LICE[1]

In October, 1917, the American Red Cross Society, in conjunction with representatives of the British Expeditionary Force, formed a committee to investigate trench fever. This body has carried out much very valuable work, but its full report has not yet been made.

About the same time a War Office Committee, under the chairmanship of Major-General Sir David Bruce, was formed in England, in order to advance the knowledge of trench fever with a view to its prevention, and the research in progress at Hampstead was merged in that of the committee, of which Major Byam became a member.

Up to the close of the year the work was confined to the study of clinical evidence, the examination of the blood and urine of patients, together with the feeding of lice on them during their febrile periods, followed by the subsequent microscopical examination of the insects with a view to the discovery of the infecting organism.

With the commencement of 1918, thanks to the financial assistance of the Lister Institute and the courageous and patriotic action of a number of volunteers, it became possible to widen the scope of the research, and very valuable results speedily followed. A confirmation was obtained of McNee's main results of direct inoculation from patient to patient by blood, and the problem of transmission by the louse was seriously attacked. The committee was fortunate in having at its disposal ample stocks of lice, free from suspicion of previous infection, which had been reared under the direct supervision of Mr. Bacot, entomologist to the Lister Institute.

The first experiments in which the insect vector was concerned consisted in two of the volunteers submitting themselves to the bites of several hundred lice daily, the insects having been previously fed on patients during febrile periods both before and during the month of experiment. The lice, therefore, had many opportunities of becoming infected, and the men received the bites of these lice three times each day for thirty days. Neither showed any of the symptoms of trench fever.

Next, following the analogies of relapsing and typhus fevers, two volunteers were inoculated from lice which had fed repeatedly on trench-fever patients. In both the inoculation

[1] From *Nature*.

was made by scratching the skin and rubbing in, eleven crushed lice in one case, and excreta voided by the lice in the other. Both men developed typical symptoms of the disease, with a relapse in six to eight days. The inoculation of louse excreta into scratches has been repeated a number of times, and in every case an attack of the disease has resulted.

It was found that the incubation in man, when infected by scarification, was remarkably constant, *i. e.*, six to eight days, and the ease and certainty with which infection could be produced pointed to the inoculation of the contents of crushed lice or louse excreta as in all probability the common, if not the invariable, method of transmission.

The excreta obtained by shaking through the gauze cover of the boxes in which the lice were confined were used in the form of a dry powder, which remained infective for at least sixteen days. In parallel experiments with the excreta of normal lice which had not been fed on trench-fever patients no symptoms of the disease were produced.

That a very small amount of blood, such as might be contained in ten lice, does not directly convey the disease through an excoriation of the skin, is indicated by the negative result obtained by rubbing 5 c.mm. of infective blood into scratches on the skin of a volunteer.

Moreover, the following series of experiments points to the fact that the louse, after a meal of infected blood, does not void infective excreta for some days. Lice were fed on a trench-fever patient on one day only, and then on healthy men. Excreta collected on the first, third, fifth and eighth days after infection gave negative results, while those collected on the twelfth and twenty-third days proved virulent. The virus, therefore, would appear to undergo some preparation in the insect before it becomes infective. Whether this change in the louse is due to a simple multiplication on the part of the hypothetical microorganism, or to a cycle in its development, is as yet undetermined. Further, it was shown that the ingestion of louse excreta did not produce trench fever in two men who daily swallowed a dose for seven and fourteen days, respectively.

GRANITE FOR BUILDING IN 1917

THE total value of granite sold for building stone in 1917 was $2,881,128, a decrease of $1,083,305, or 27 per cent., compared with 1916. The rough stone sold was valued at $590,310, which was $312,736, or 35 per cent. less than in 1916; the dressed or manufactured stone was valued at $2,290,818, which was $770,569, or 25 per cent., less than in 1916. Accurate figures showing quantities are not yet available, but owing to a general increase in price the decrease in percentage of output was considerably more than in value.

The statistics given were compiled under direction of G. F. Loughlin, of the United States Geological Survey, in cooperation with the National Building Granite Quarries' Association and the State Geological Surveys of Georgia, Maryland, Minnesota, Missouri, New Jersey, New York, North Carolina, Pennsylvania, Virginia, Washington and Wisconsin.

Sales of granite for building were reported from 26 states in 1917 compared with 28 in in 1916. Massachusetts, with a total value of $646,506, and Maine, with $525,604, ranked first and second. New Hampshire, second in rank in 1916, was third in 1917, with a value of $337,233. Massachusetts, with $132,700, and Maine, with $109,941, were the only states whose sales of rough granite exceeded $100,000 in 1917, and each of these showed a decrease of about one third compared with 1916. New Hampshire followed with $78,484, a gain of about one quarter. Pennsylvania, which ranked first in sales of rough granite in 1916, with a value of $224,360, was credited with only $87,978 in 1917. The few other states that showed gains had values of less than $15,000.

In sales of dressed granite also Massachusetts, with $513,806, and Maine, with $424,663, were the leading states. Maine, however, has made continuous gains in 1916 (2 per cent.) and 1917 (55 per cent.), whereas Massachusetts in the same years has suffered losses of 17 per cent. and 19 per cent., respectively. North Carolina's output, chiefly stone for mausoleum work, though classed previously as

building stone, has been transferred to monumental stone, the class in which it more properly belongs. New Hampshire, Vermont, California, Georgia, Rhode Island and Minnesota had values in excess of $100,000 in 1917. Of these Georgia made gains in the last two years, its value for 1917 nearly doubling that of 1915, and Rhode Island more than tripled its value for 1916. The other states named showed decreases of 10 to 50 per cent.

The reduced output during the last year was due to a marked increase in the cost of labor, material and freight. The general average increase was probably about 30 per cent., but some items increased much more.

Prices increased, though in most places not in proportion to the increase in costs. Some producers reported an increase of 20 to 30 per cent. One company in Maine reported an increase of 50 per cent., and two companies in New Jersey an increase of 100 per cent. for rough stone. A few companies in New Hampshire, Maryland and the District of Columbia reported no increase in price.

The demand was prevailingly small, owing to a general curtailment in the erection of both government and private buildings in which granite is ordinarily used. This curtailment in turn was caused by a shortage of labor for building, a shortage of other building materials, and the increased price of these materials and of building stone.

As building operations were very active early in 1917, the curtailment in them not becoming marked until about midsummer, the production in 1917 may be considered an average between very good and very poor. The period of severe depression continued through the first six months of 1918, and as there is no prospect of early improvement the production of building stone, as well as of other materials that are used mainly in buildings of the better classes, will probably be considerably less in 1918 than in 1917. The present abnormal period, in which most of the buildings erected are temporary, will probably be followed by a period in which permanent buildings of high architectural merit will be constructed, and this change will be reflected in a rapid recovery of the building granite industry.

THE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

THE following report from the editorial board of the *Proceedings of the National Academy of Sciences* was presented by the chairman, Raymond Pearl, at the spring meeting of the academy and is now printed in the *Proceedings*.

1. Three volumes of the *Proceedings* have been completed, and four numbers of the fourth volume have been issued.

The statistics as to the make-up of the third volume, both in respect of subject-matter and of source of the contributions, have been printed in the Annual Report of the Academy for 1917, and need not now be repeated except so far as covers one point.

The statistics of articles by members of the academy as compared with articles by non-members are interesting mainly in showing a progressive diminution in the percentage of articles by members, despite the increase in membership of the academy. If there are obstacles which can be removed and which hinder members of the academy from printing in the *Proceedings*, would it not be well to make efforts to remove them? The academy represents the highest point in American research, and if the *Proceedings* should actually contain articles representing the totality of the investigations of members of the academy it would become thereby largely representative of all American research and of very high grade, and furthermore it would be more truly the proceedings of the academy in the sense that corresponding publications of foreign academies are representative of their research.

2. At the autumn meeting the terms of office of five members of the editorial board expired, and new appointments were made by the council as follows: Jacques Loeb, W. M. Wheeler, E. B. Frost, E. L. Thorndike and E. H. Moore.

3. At the autumn meeting the board decided to put into operation certain changes in the typographical make-up of the *Proceedings* in the interest of economy. These changes have been made with satisfactory results.

4. The editorial board is of the opinion that in view of the now established and recognized position of the *Proceedings* as a medium of scientific publication, the members of the academy might well contribute more of their own papers to its pages than they now do, both from the standpoint of self-interest as well as from a sense of duty to the academy and what it stands for. In this con-

nection the board would recommend that the academy adopt as a general principle the policy of requiring each recipient of a grant for research from any of its special funds to publish some account of the results of the researches under the grant in the *Proceedings*.

5. If the above recommendation is adopted, the board would further recommend that the academy suggest to the several committees having in charge trust funds from which grants are made that whenever accounts of researches under grants are published in the *Proceedings* there shall be paid over from the trust funds out of which the grants are made, to the *Proceedings* account, if such action be permissible under the terms of the bequest, a sum of money to cover the expense of the publication at a rate of $6.00 per printed page.

Anent the above report the following recommendations were submitted from the council and adopted.

That the following recommendations from the editorial board of the *Proceedings* be approved by the academy and that the home secretary be instructed to bring these recommendations to the attention of the members of the academy and the chairmen of the trust funds.

That members of the academy be requested to contribute their own papers to the *Proceedings*.

That the policy of requiring each recipient of a grant for any research from any of the special funds to publish an account of the results of the researches under the grant in the *Proceedings* be approved.

That the academy request the committees and trustees of the several trust funds of the academy from which grants are made that whenever accounts of researches under grants are published in the *Proceedings* there shall be paid over from the trust fund out of which the grants are made, to the *Proceedings* account, if such action is permissible under the terms of the bequest, a sum of money to cover the expense of the publication.

A report was received from the finance committee of the *Proceedings*, signed by C. B. Davenport, chairman, F. R. Lillie and Raymond Pearl, as follows:

The estimated net cost of the *Proceedings* for 1918 is $5,600.

The estimated income is as follows:

From subscriptions (provided each member of the academy becomes responsible for one subscription)	$1,800
One third guarantee fund of $2,500	833
Estimated income of Billings Fund	187
Sundry other income (members dues, $850; N.R.C., $400; Dr. Walcott, special, $100)	1,350
Total estimated income	$4,170
Total estimated deficit	$1,430

If recommendation of the editorial board that space for reports of special grants in Proceedings be specially paid for be adopted, this deficit will be reduced to $1,200.

The committee plans to raise funds to meet this deficit.

SQUAW ISLAND, NEW YORK STATE MUSEUM RESERVATION

The New York State Museum, which has already taken over, with the aid of appreciative citizens, several interesting properties in the state of New York for the purpose of recording and conserving their geological attractions, has recently come into possession of Squaw Island in Canandaigua Lake. The spot is of special geological interest from the fact that the island is made up of deposits of algal lime concretions or "water-biscuit" formed by the precipitation of lime carbonate through the activity of growing algæ which coat the shale pebbles of the beaches. A brook flowing in from the north over the limestone region brings waters that are well saturated with lime carbonate, and these waters washing against the barrier of Squaw Island have the excess of carbon dioxide stolen away by the growing algae so that the lime carbonate precipitates immediately upon the beach material and in this way the so-called water-biscuits are built up contemporaneously with the growth of the algæ. These algal lime balls, on solution in acid, leave behind a matted felt of algal threads of the same size as the hardened ball showing contemporaneous growth and activity throughout the period of deposition. Squaw Island has become well known to students of paleontology for the light these water-biscuits have thrown upon the formation of the great algal reefs such as the Cambrian Cryptozoon ledges of New York and the Pre-cambrian Algal ledges which have recently been described by Walcott from the Rocky Mountains.

SCIENTIFIC NOTES AND NEWS

Professor Wilder D. Bancroft, of the department of chemistry of Cornell University, who has been engaged in government work since our entry into the war, has been commissioned a lieutenant colonel in the Chemical Warfare Service.

There has been organized at Dijon a scientific society or *cercle* for the purpose of amalgamating Franco-American interests in this special territory. The presidents are Major W. B. Cannon, of the United States Army, and Professor Bataillon, dean of the faculty of science. Among those present at the first meeting were American military medical officers, the médecin chef de la Place, the members of the Corps de santé français, the professors of the faculty of science and of the Ecole de médecine et de pharmacie de Dijon.

Mr. Henry Griscom Parsons, supervisor of gardening instruction at the New York Botanical Garden, has been commissioned with the rank of captain in the Quartermaster's Department of the Army, and has been assigned to the Conservation and Reclamation Division, salvage and gardening branch, being put in charge of the farming and gardening operations at the various cantonments, with headquarters at Washington.

Dr. Simon Flexner, of the Rockefeller Institute for Medical Research, has been elected a foreign member of the Swedish Medical Society at Stockholm.

Dr. W. J. Spillman has resigned as chief of the Office of Farm Management in the United States Department of Agriculture to accept the editorship of *The Farm Journal* at Philadelphia. For the present he will continue to reside in Washington.

Dr. Harry S. Bernton, pathologist to the Pennsylvania State Board of Health, has resigned to become the chief of the bureau of preventable diseases and director of the biologic laboratories of the Health Department of the District of Columbia.

A party of agricultural experts of the bureau of plant industry of the United States Department of Agriculture have been sent to Algeria, Tunis and Morocco to investigate and advise on the possibilities of increasing the agricultural output of those French colonies. The visit is to be made at the request of the French High Commission now in the United States. The party is composed of E. C. Chilcott, in charge of the dry farming investigations of the bureau; C. S. Scofield, in charge of the bureau's work in development of irrigation agriculture, and T. H. Kearney, in charge of important work with alkali and drought-resistant crops.

Dr. W. A. Cannon, of the department of botanical research of the Carnegie Institution, expects to be in Australia for about twelve months, where he will make field studies of desert plants with special reference to root habits.

Henry Hinds has returned to Washington from Panama and Costa Rico, where he was acting chief geologist for the Sinclair Central American Oil Company. He is now serving as geologist for the U. S. Geological Survey and the Fuel Administration, in charge of the work of furnishing geological advice for the use of the Capital Issues Committee in considering the applications of oil and gas companies to issue stocks and bonds for development purposes.

Dr. Karl T. Compton, formerly of the department of physics of Reed College, is now in Paris as a technical assistant with the Research Information Committee authorized by joint action of the Secretaries of War and Navy.

Professor Hudson B. Hastings, of Reed College, has been engaged by the Food Administration as economic and statistical expert in the study of problems arising in connection with the salmon and milk industries.

Dr. S. I. Kornhauser, associate professor of zoology at Northwestern University, has entered the Sanitary Corps of the army as a lieutenant and will report at the Brady Laboratory, New Haven.

Assistant Professor Asa C. Chandler, Ph.D., of the department of zoology and physiology in the Oregon Agricultural College,

has been appointed second lieutenant in the sanitary corps of the army and is on detail service at the Rockefeller Institute, New York City.

The death is announced of Dr. R. G. Hebb, consulting physician and pathologist to the Westminster Hospital, secretary to the Royal Microscopical Society from 1898 to 1911, editor of the *Journal of the Royal Microscopical Society*, from 1902 to the time of his death.

A number of news photographers are urgently needed by the Signal Corps. These men must have expert experience in handling of speed cameras, such as Graflex and Graphic, and also understand speeds of lenses and various makes of cameras and their operation. Only those men who can furnish references as to their actual experience as news photographers will receive consideration. The men selected for this branch of the service will be sent to a school for military training. Upon completion of the training they will be promoted to grades of sergeant, first class, and will be ordered overseas in a short time. Applicants must be citizens of the United States between the ages of twenty-one and thirty-one.

The U. S. Civil Service Commission announces an examination for scenario editor, for both men and women, on September 18, 1918. A vacancy in the Department of Agriculture, Washington, D. C., at $1,600 a year, will be filled from this examination. The duties of the appointee will consist of preparation and editing of educational motion-picture scenarios dealing with agriculture, home economics and other subjects covered by the work of the Department of Agriculture, the writing of subtitles and descriptions of motion pictures on such subjects, and the preparation and editing of other similarly written educational material.

The *British Medical Journal* states that during the summer school, Cambridge, Sir William Osler, on August 7, gave a sketch of the evolution of scientific medicine in the United States, illustrated by lantern slides. He divided the story into four periods. The first, British, to 1820, concerned with medicine among the early colonists, tracing the influence of Edinburgh and of John Hunter, and coming down to the New England group illustrated by Jacob Bigelow and James Jackson. The second, French, period extended from 1820 to 1860, when the influence of Laënnec and Louis was supreme; of the third, German, period extended from 1860 to 1890, the main features were specialism at the Vienna school, the teaching of Virchow and Koch, and the work of Traube in experimental medicine. The fourth period is the American, from 1890 to the present day, its chief features being the reorganization of hospitals as integral parts of the university system, and unit and team work illustrated in the clinics of Cushing, Halsted and the Mayo brothers.

A medical division has been established in the Provost Marshal-General's Office. The first step was the appointment last February of Dr., now Colonel, Frank Billings, who was assigned as medical aide to the Provost Marshal-General. But since that time the medical phases have developed to such an extent that the enlargement of this position into a specific division in the Provost Marshal-General's Office has followed. The personnel of the medical division consists of Colonel F. R. Keefer, of the regular medical corps, chief, assisted by Major Hubert Work and Captain D. Chester Brown.

The British Board of Agriculture and Fisheries has appointed a committee to study the life habits of the honey bee with the object of improving the conditions under which bee-keeping is carried on in England and Wales, and to investigate the epidemic diseases of the bee, more especially the disease or group of diseases which pass under the name of "Isle of White" disease. The committee consists of: The Master of Christ's College, Cambridge (Dr. A. E. Shipley, F.R.S.); Professor Punnett, F.R.S. (professor of genetics, Cambridge); Dr. G. S. Graham Smith, M.D.; Professor G. C. Bourne, F.R.S., D.Sc. (professor of zoology and comparative anatomy, Oxford); Professor W. Somerville (professor of rural economy, Oxford); Mr. T. W. Cowan (chairman of the British Bee-keepers Association);

Mr. G. W. Bullamore; Mr. J. C. Bee Mason; and Mr. A. G. L. Rogers (head of the Horticulture Branch, Board of Agriculture and Fisheries). Mr. R. H. Adie will act as secretary. It is proposed to undertake the study of healthy bees at Cambridge and the investigations on Isle of Wight disease at Oxford. The committee would be glad to receive specimens of bees suspected of suffering from "Isle of Wight" disease for examination and experiment.

The American Public Health Association will meet at Chicago from October 14 to 17. Some of the military sanitarians who will address the meetings are Surgeon-General Gorgas, Colonel Victor C. Vaughan, and Major William H. Welch of the Army Medical Corps. Other speakers at the general sessions will be George H. Vincent, president of the Rockefeller Foundation; Dr. Charles J. Hastings, president of the American Public Health Association; D. W. A. Evans, Assistant Surgeon-General Allan J. McLaughlin, U.S.P.H.S., Dr. Ernest S. Bishop, Dr. Lee K. Frankel, Dr. Frederick L. Hoffman and others.

One motion-picture film is now being supplied every two weeks by the United States Department of Agriculture for release in the *Universal Screen Magazine*. These films show in an interesting and educational manner some of the activities of the department and of the important lessons which the department is trying to teach. Films that have already been released show work of the pig clubs, road building, forest-fire prevention, poultry management, cattle and sheep grazing on the national forests, types of horses, cooperative berry growing in the Pacific Northwest, the government's method of tree planting on the national forests, how the department regulates logging in the national forests, and the work of the forest ranger.

The War Department authorizes the statement that as a result of the studies at the front, methods have been developed whereby more than 80 per cent. of the wounded, who originally remained at the military hospitals for months, are now cured and returned to the forces in three or four weeks. In order that Army surgeons stationed at camps, cantonments and other military hospitals in this country may thoroughly understand the latest treatment of war wounds, the Army Medical Department has had established special classes of instruction to which are sent selected officers who, upon completion of their courses, return to their own hospitals and instruct other surgeons in these methods. The earliest possible information of changes of treatment are sent to the Surgeon-General's Office from the American Expeditionary Forces, and these in turn are immediately transmitted through the classes and, by means of moving pictures, lantern slides and pamphlets, to every surgeon who will come in contact with these wounds either at home or at the front. Since last October more than 150 officers have received special instruction each month in classes which have been established at the War Demonstration Hospital, Rockefeller Institute; four classes at Bellevue Hospital, New York, Roosevelt Hospital, New York, University of Pennsylvania, at Philadelphia, Rochester, Minn., Pittsburgh, Chicago, New Orleans and San Francisco. All surgeons who will come into contact with war wounds have received instruction in the methods of administering the Carrel-Dakin treatment, and sufficient apparatus has been furnished to treat every patient in the service who may require this method. A large supply of apparatus has been sent to Europe so that there are now more than 50 sets available for every injured man who, up to the present time, has needed this treatment, and over 8,000 sets are being shipped every month to care for the added number of wounded in which this application may be necessary.

At a meeting of the board of directors of the American Institute of Mining Engineers, recently held in New York, it was decided to drop all enemy aliens from membership. The meeting, which was under the chairmanship of Sidney J. Jennings, president of the institute, was attended by twenty-three of the

twenty-five directors, among them the chairman and four members of the naval consulting board. The action of the board of directors is said to affect the status of twenty-one German men of science and one Austrian professor who held either honorary or active membership in the association. The institute now has a membership of about 6,600 in this country and there are more than 1,000 members abroad.

DR. GEORGE D. HUBBARD, head of the department of geology at Oberlin College, spent the summer in Wyoming doing research work for the federal government. Dr. Hubbard's special problem was the location of war materials, particularly petroleum. His course in the Oberlin Summer School in the principles of geography was given by Mr. E. T. Thomas, supervisor of geography in the Shaker Heights Schools, Cleveland, Ohio.

UNIVERSITY AND EDUCATIONAL NEWS

REED COLLEGE is awaiting the decision of the War Department and the Federal Board for Vocational Education in regard to the college's offer to undertake extensive service in the reeducation of the wounded for industrial activity. An offer of $200,000 in equipment for a school of this nature and another offer of grounds and buildings suitable for a convalescent hospital and remedial workshops have been made to the college.

PLANS have been prepared for a laboratory building for the Yale Medical School, New Haven. The building is to be of brick and steel construction.

THE West Riding Education Committee has renewed for another year its grant of £500 to the Department of Glass Technology at Sheffield University.

As a memorial to their son, William Frederick Drughorn, an old King's scholar, killed in action, Mr. and Mrs. Drughorn have endowed King's School, Canterbury, with laboratories, to be known as the Drughorn Science Buildings, at a cost of £25,000.

PROFESSOR ELIAS J. DURAND, of the University of Missouri, has been appointed to a professorship of botany in the University of Minnesota.

DR. ALBERT EDWARD HENNINGS, of the University of Saskatchewan, Canada, has been appointed to an assistant professorship in the department of physics of the University of Chicago. The following promotions have also been announced: Associate Professor Albert Johannsen, of the department of geology, to a professorship; Assistant Professors Albert D. Brokaw and Rollin T. Chamberlin, of the same department, to associate professorships; and Dr. Eugene A. Stephenson, of the same department, to an assistant professorship.

DR. HARRY SHIPLEY FRY, former associate professor of chemistry, has been appointed professor and head of the department of chemistry at the University of Cincinnati. Other appointments in this department are as follows: Dr. Earl F. Farnau, associate professor of organic chemistry, formerly assistant professor of chemistry at New York University; Dr. Ralph E. Oesper, associate professor of analytical chemistry, formerly assistant professor of chemistry at Smith College; Dr. Clifford J. Rolle and Dr. Leonora Neuffer, instructors in chemistry.

CHARLES L. RAIFORD, Ph.D. (Chicago), head of the department of chemistry at Stillwater, Oklahoma, has been elected associate professor of chemistry at the University of Iowa. He will take charge of some of the classes of Professor Hixson, who is now consulting chemical engineer in the ordnance department of the U. S. Army.

ERIC THERKELSEN, who for several years has been a member of the engineering faculty of the University of Washington, has accepted an assistant professorship of mechanical engineering at the Montana State College.

DISCUSSION AND CORRESPONDENCE

BARLEY BREAD, OPTIMUM REACTION AND SALT EFFECT

WHEN the attempt is made to make barley bread with a wheat flour content lower than

70 per cent., the result is a heavy, sour bread. The difference in chemical composition between barley gluten is scarcely sufficient to account for the difference in behavior of the two flours to yeast (Plimmer):

	Wheat	Barley
Total protein	10.00	11.00
Gliadin	4.25	4.00
Glutenin	4.00	4.5

Accordingly, it seemed that physical chemical factors might enter into the question. With some colloids at least, the viscosity is increased by raising the content of inorganic salt (Loeb) and this is apparently what is desired in the case of barley gluten.[1] At the same time, it seemed desirable to determine the optimum hydrogen ion concentration of some of the flours in the presence of yeast. Accordingly, the following experiments were performed:

Wheat, barley, rice and potato flours were used. When prepared without wheat, rice and potato flours failed to rise, owing to the lack of a protein similar to gluten, whose physical characters permitted the holding of the gases, CO_2 especially, to "lighten" the dough. When used with distilled water, barley flour alone gave practically the same sort of bread as that when wheat flour is used in amounts smaller than 70 per cent., the heaviness and sourness rendering its use impossible. An attempt was made to mix barley and rice, barley and potato, etc., but the results were even worse than with barley alone.

The influence of various degrees of alkalinity and of acidity were then examined. By the aid of the chart of Sørensen, mixtures of KH_2PO_4 and Na_2HPO_4 were made. Twenty-five grams of barley flour were weighed into an evaporating dish and 35 c.c. of one of the various solutions were added, together with one gram of Fleishman's compressed yeast. The whole was then intimately mixed, transferred to a cylinder and left to rise at 35° C. for one half hour, in the constant temperature room. Solutions of phosphates were used as follows: Ph = 8.0, 7.6, 7.4, 7.0, 6.4, 6.0, 5.2, 4.6. The optimum rise was obtained at 5.2 and later it was determined that with solutions at Ph = 5.0, the best results were obtained. Controls were conducted with wheat flour, using distilled water.

In passing it may be remarked that similar experiments with wheat flour have the optimum at a lower acidity than that given here for barley flour.

It has been supposed that there is a specific chemical effect in the phosphates, owing to the difference in phosphate composition in wheat and other gluten-bearing flours. Inasmuch as we are able to use lactic and acetic acids at Ph = 5.0, it seems that the effect is rather one concerned with reaction.

After the dough had risen, the preparation was removed and mixed with ten grams of fresh barley flour, the whole kneaded well and transferred to a pyrex beaker which was placed in an electric baking oven for one hour at 220° C. Besides barley flour, we also used rice and potato flours, separately, but without improving the resulting bread.

The bread thus made is fairly good and greatly superior to that made from water preparations.

We repeated the experiment just described with barley, this time using 2 per cent. NaCl (introduced dry) in the dough. A much lighter loaf was obtained, the initial rise being greater and the subsequent dough on the second rising being more similar to that of wheat preparations. A good crust is formed and there is less sourness, characteristic of all barley breads.

It is apparent, then, that by maintaining a reaction approximating Ph = 5 and a sodium chlorid content (added) of 2 per cent., barley flour may be utilized by itself to make a passing war bread. By suitable manipulation, we have little doubt that an experienced baker can derive a formula whereby an excellent bread can be produced at will.

LORRAINE L. LANDENBERGER,
WITHROW MORSE
MICHAEL REESE HOSPITAL,
CHICAGO

[1] *Cf.* Upson's work.

CONCERTED BEHAVIOR OF TERRESTRIAL MOLLUSKS

ON August 29, 1915, the writer collected 125 specimens of *Cochlicopa lubrica* (lot 146*a*) from the outer surface of the door and frame of the "dark room" at the Iowa Lakeside Laboratory, on Lake Okoboji. This small frame building is more than half imbedded in the hillside about 15 feet above the level of the lake. The roof is covered with humus dirt and vegetation. A short passageway walled with heavy boards leads to the doorway.

Throughout the preceding night there had been a constant, cold rain. On the morning of the 29th there was a cold, drying wind. On the afternoon of this day I chanced to notice a specimen of *Cochlicopa* on the door-frame; closer examination then revealed a good many, and I spent an hour or more in gathering them. Those attached to the walls were at all heights, with the apex directly downwards, which latter fact, I presume, indicates that their movement had been upwards. None of the specimens were moving at the time, but all were retracted and fastened by a secretion to the substrate. Doubtless this condition is explained by the fact that the wind had made the planks so dry that locomotion was difficult or impossible. Ten or fifteen specimens were picked up from the ground close to the wall, but were inactive and lay as they had fallen. A few, also, were found in cobwebs, by which they had been caught as they fell from the vertical walls. While a few specimens were found on the south wall, most were on the north wall (which faced the south) and the northeast corner of the building (which faced east to north). Besides the *Cochlicopæ*, a considerable number of specimens of *Vallonia gracilicosta* were found; and also about fifteen specimens of *Bifidaria armifera*. However, the two latter species did not exhibit any uniformity in orientation, so far as noticed, at least.

Concerning the *Cochlicopæ*, the writer was puzzled to account, not only for their presence in rather large numbers, but for the singular uniformity of their behavior. The snails on the vertical walls were at all heights from the ground, and all exhibited precisely the same orientation, viz., the apex of the shell pointed downward. They evidently had come from the ground below. But why should they be moving upward? Under conditions of drouth and cold one would expect these forms to exhibit a positively geotropic response. Close to the water's edge among the rocks and fallen leaves the writer had been accustomed to find this species rather common; but never so many in a given area as occurred on this occasion. None had ever been found on this slope so far up, before.

It seemed to the writer that so many of these snails being found together, and with similar orientation, was a fact inviting explanation, which, however, he is unable to furnish. This case differs from the synchronic behavior recently described in SCIENCE by several authors, in that it lacks the element of rhythm. In the movement of the group of harvestmen, as described by Newman, and the simultaneous movement of the fall web-worn, described by Peairs, there is a rhythmic group movement which may be distinguished from concert of action. And while I am unable to explain the behavior of these snails, I am inclined to look upon it as a sort of concerted action.

T. C. STEPHENS

MORNINGSIDE COLLEGE,
SIOUX CITY, IA.

A COUNTRY WITHOUT A NAME

TO THE EDITOR OF SCIENCE: I am glad to see that some one has at last had the insight and courage to note and call attention to the fact that our nation has no name. "The United States" is no name at all, and merely because we call the United States of Mexico "Mexico," and the United States of Brazil "Brazil," is no justification for calling the United States of America "America." Our brothers to our north call us "the States," which is about as meaningless as anything can be, but it is our own fault that we are so called. Some years ago there was a popular musical comedy containing a song entitled "My own United States," but it could arouse no thrill with such a handicap. Indeed we do need a national name more than a national flower,

though I do not know what we can do now to correct our faulty condition, one hundred and forty years after the birth of our nameless nation. Would that our fathers had seized upon our beautiful nickname, "Columbia," for our own official designation, before our pugnacious southern neighbor Columbia had stolen it for herself!

J. S. Moore

Western Reserve University,
Cleveland, Ohio

To the Editor of Science: The name "America" inspires millions of individuals and the logical necessity for a name which is more specific, as pointed out by one of your correspondents in Science of July 5, will gain little acknowledgment and no popularity. Nevertheless the necessity remains and should be dealt with. The custom and sentiment of the masses is the deciding factor and any change can come only by a gradual transformation. If the term America, like Europe, Africa and Asia applies to a continent, as it does, then American implies Canadian, Brazilian and Patagonian just as well. We have in our case the modifying factor of "United States," which, as the correspondent puts it: "is lacking an adjective." To supply this adjective another name is needed. Why not hit two marks in one stroke by printing upon our postage stamps: USoNA? Perhaps this name might gain popularity and would permit an adjective "Usonian." At the same time the most numerous representatives of the nation would sail under a more specific label: U. S. o. N. A. instead of U. S. POSTAGE. Incidentally I wonder how long the inaccurate use of U. S. A. will survive. It has often been pointed out that U. S. A. is the official abbreviation for "United States Army" and U. S. N. for the navy, while U. S. means the United States and U. S. N. A. the United States of North America. Perhaps an experiment with postage stamps, as suggested above, may educate the people to use Usona, or the correct U. S.

Ingo W. D. Hackh

Berkeley, Calif.

SCIENTIFIC BOOKS

City Milk Supply. By Horatio Newton Parker. New York, McGraw-Hill Book Company, Inc. Pp. 486.

The author's purpose is plainly set forth in the brief preface, namely to give much-needed information on the broad subject of milk production, transportation and control of purity. This purpose he has admirably accomplished. The book seems complete in itself. The subject matter is divided into seven chapters, as follows: I. Milk; II., Diseases Communicable in Milk; III., Dairy Cattle and the Dairy Farm; IV., Sanitary Milk Production; V., Transportation of Milk; VI., The Milk Contractor, and VII., Control of the Public Milk Supply.

Printed in somewhat compact form, in good bold type and on good paper, the different topics are presented clearly, and in many parts with the first-hand information and understanding of the various difficult problems which only one who has spent many years of study in this field is able to give.

In the chapter on diseases communicable in milk the treatment of tuberculosis is particularly instructive. The tuberculin test, and the present-day controversy regarding its value and enforced application are discussed at some length and without bias. Septic sore throat likewise comes in for a good share of the writer's attention.

A comprehensive history of the score card system of rating dairies, and a full discussion of its merits and of its serious limitations will be found to be interesting and illuminating. The importance which the author attaches to the bacteriological examination of milk is most gratifying to those who have long lent their support to its complete adoption as a method of controlling sanitary milk production. A good account is given also of the origin and pernicious influence of the so-called "slop dairy," and of the long struggle that has been waged for improved feeding and housing conditions in the dairy barn.

The author has been particularly successful in his treatment of the material in the chapter on the milk contractor. The peculiar

relations of the contractor to both the producer and consumer are well portrayed, and the many and almost insurmountable problems of bringing milk to the doors of the consumers in as pure a state, and as quickly as possible, without prohibitive cost, are clearly presented and discussed from every possible angle. The pages in the last chapter on municipal and state control of milk production and distribution, with types of ordinances as examples, should be of much interest to health officers and milk inspectors. The practical application of scientific principles to milk production, and the different bacteriological and chemical methods and standards for controlling the purity of milk, receive their due share of attention. The book concludes with a discussion of infant mortality.

It is unfortunate that grammatical errors should have been allowed to creep into the book here and there, as for example the following: "Enough data *has* been collected" (page 180), and "the relations between the farmer and city milkman *is* delicate"; and in the use of scientific names, as for instance in "streptococci, staphylococci and *bacteria* were found." A very common error in punctuation is the absence of the comma between the principal parts of a compound sentence, especially where the conjunctive "but" is used. These are, however, but minor defects which will undoubtedly be eliminated from future editions.

The author does not claim originality, but as he states, has drawn from a wide field of experience of others, experts in their own domain, who have been given full credit, and to whose work references are given at the end of the individual chapters. Throughout the book original tables and illustrations materially add to its value.

Leo F. Rettger
Sheffield Scientific School,
Yale University

SPECIAL ARTICLES

CORPUS LUTEUM AND THE PERIODICITY IN THE SEXUAL CYCLE

In a recent paper G. W. Corner and F. H. Hurni report on experiments in which they injected intraperitoneally rats with suspensions of corpus luteum preparations.[1] In all but one animal the substance prepared by Armour & Company was used.

While Corner and Hurni find that such injections may cause peritoneal adhesions and peritonitis, they failed to inhibit ovulation. So far the experiments of these authors are essentially in agreement with the results not mentioned by Corner and Hurni which I previously obtained in guinea-pigs.[2] I stated:

> While in some injected guinea-pigs ovulation was apparently delayed, in others it took place at the expected term despite the fact that these animals had repeatedly received large doses of lutein. We may therefore conclude that injections of lutein extract can not wholly take the place of the living corpus luteum. Whether or not they can do so partially in mammals, I am not prepared to say on the evidence at hand.

Some details as to doses used in these experiments are found in a paper in which in conjunction with Dr. Cora Hesselberg I reported on the effect of such injections on the cycle of the mammary gland in the guinea-pig.[3]

Our experiments on the effect of injections of corpus luteum substance had been suggested through positive results which R. Pearl and Surface had previously published concerning the retarding effect of such injections on the ovulation in birds.[4]

We emphasized the negative character of our results, because a slight delay in ovulation can be induced in the guinea-pig through various experimental interferences, and especially did we find that undernourishment prevented the normal maturation of follicles.[5]

The experiments in which ovulation oc-

[1] George W. Corner and Felix H. Hurni, *American Journal of Physiology*, 1918, XLVI., 483.

[2] Leo Loeb, "Surgery, Gynecology and Obstetrics," 1917, XXV., 300.

[3] Leo Loeb and Cora Hesselberg, *Journal Exper. Medicine*, 1917, XXV., p. 305.

[4] Raymond Pearl and F. M. Surface, *Journal Biol. Chem.*, 1914, XIX., p. 263.

[5] Leo Loeb, *Biological Bulletin*, 1917, XXXII., p. 91.

curred at the normal term, notwithstanding the injections, seemed to us therefore of greater significance. Corner and Hurni, however, go further in their conclusions and state: "Thus it would seem that Loeb's experiments do not prove an acceleration of ovulation following the removal of the corpora lutea."

This conclusion rests (1) on the lack of effect of the injection of dried corpus luteum substance in inhibiting ovulation. (2) On the alleged proof given by Stockard and Papanicolaou that I assumed the normal sexual cycle in the guinea-pig to be longer than they found it to be by a method which they believed to be superior to the one which I used.

Inasmuch as, to my knowledge, my investigations provide the essential experimental basis for the conclusion that the corpus luteum has the stated function, and that the denial of the correctness of my conclusion would invalidate the significance of the corpus luteum as an important factor in the mechanism regulating the sexual cycle, I believe it advisable to inquire whether or not the statement made by Corner and Hurni is warranted by facts.

Without going into a detailed restatement of the results which I have published in a series of preceding papers, I may give a brief summary of some of the essential results obtained. In a first series of investigations I determined the duration of the sexual cycle in guinea-pigs in which in most cases the uterus had been subjected to certain experimental interferences in the early period of the sexual cycle.[6] It was found that while in these cases the second ovulation may occur as early as 16–18 days after the first ovulation, it occurred quite commonly somewhere between the twentieth and thirtieth day after ovulation; this was found to be so, especially in cases in which through incisions made into the uterus deciduomata had been produced experimentally. In a series of guinea-pigs in which the uterus had been treated in a way similar to the control series, but in which, in addition, at an early stage of the sexual cycle the corpora lutea had been completely extirpated with a knife, ovulation occurred in the large majority of cases between the twelfth and sixteenth day after the first ovulation. A period of approximately 9 to 18 days following an ovulation is required for the new formation of mature follicles in the guinea-pig, each ovulation in the guinea-pig being accompanied by an atresia of all but the smallest follicles.[7] While this series, as such, proved the significance of the corpus luteum for the duration of the sexual cycle, the correctness of our interpretation was made certain by our further finding that while in the normal course of pregnancy ovulation does not occur in the guinea-pig, after a preceding extirpation of the corpora lutea about 6–7 days following copulation the pregnancy may proceed, but an early ovulation occurs, notwithstanding the presence of pregnancy just as it does after extirpation of the corpora lutea in the cycle unaccompanied by pregnancy. In this case the difference in the time of ovulation is so great as the result of the extirpation of the corpora lutea that an error of interpretation can be excluded with certainty.

Extirpation of the corpora lutea did not exert this effect on the sexual cycle in a purely mechanical way; excision of control pieces of ovarian tissue did not have the typical effect; neither did such cases respond in which the extirpation of the corpora lutea was incomplete. Complete extirpation of corpora lutea on the other hand exerted its effect on both ovaries, even in cases in which one of the two ovaries had been free from corpora lutea at the time of extirpation. It was probable that this inhibiting effect of the corpus luteum was due to the secretion of a substance on the part of the corpus luteum.

In further experiments I showed that the presence of the corpus luteum did not inhibit the maturation of follicles, but merely the rupture of mature follicles.

In my first publication I called attention to the possibility that the experimental interfer-

[6] Leo Loeb, *Deutsch. mediz. Wochen.*, 1911, No. 1. *Zentralblatt f. Physiol.*, 1910, XXIV., No. 6; 1911, XXV., No. 9.

[7] Leo Loeb, *Journal of Morphology*, 1911, XXII., p. 37. *Virchow's Archiv*, 1911, CCVI., 278.

ence with the uterus which was practised in these cases might somewhat modify the duration of the sexual cycle, but that if such a modification did exist, it applied equally to experiments in which the corpora lutea had been extirpated and to control cases. Therefore our conclusions concerning the inhibiting function of the corpus luteum was not affected by such an interference. However, we had intended to continue our investigation in this direction and in later determinations we found, in guinea-pigs in which the uterus had not previously been interferred with, the length of the sexual period to vary between 15 and 18 or 19 days.[8] In two cases we observed the new ovulation as early as 13½ to 14½ days after the preceding ovulation. A certain latitude exists therefore in the periodicity of the normal sexual cycle.

Again we could confirm our previous results: Excision of the corpora lutea carried out within the first week after copulation brings about a new ovulation between the tenth and fifteenth day after copulation in the majority of such cases, and we were able to observe it as early as 8½ and 9 days after copulation.

As in our previous experiments pregnancy did not prevent the early ovulation after a complete extirpation of the corpora lutea. It is only the persistence of the corpora lutea of pregnancy which prevents ovulation.

While in our previous investigations we had studied mainly the cyclic changes in the ovaries and only incidentally referred to cyclic changes, in the uterus, in the last-named paper we extended our studies to the cyclic changes in the uterus and to the correlation of the cyclic changes in the uterus and ovaries. In our determination of the sexual cycle we made use of the following criteria:

1. Whenever feasible the period of heat was observed; the behavior of the animal as well as the condition of vulva and vagina serving as indicators, which in the hands of an experienced breeder gave reliable results as the subsequent macroscopic and microscopic examination of uterus and ovaries proved in each case. In other animals the observed copulation indicated the approximate time of ovulation. We followed the cyclic changes in uterus and ovaries from day to day and could thus establish a definite and orderly sequence of events. By correlating the condition of the corpora lutea, follicles and uterine mucosa, it was possible to determine the stage of the sexual cycle of the observed guinea-pigs with a precision which was entirely adequate for our purposes. Thus to mention only one instance it was possible by microscopic examination of the uterus alone without examination of the ovaries to determine whether in an animal at an early stage of the sexual cycle ovulation had or had not taken place.

Subsequent to our last mentioned investigations, Stockard and Papanicolaou[9] published a study of the sexual cycle in the uterus of the guinea-pig, in which they used the naked eye observations of vaginal changes as a criterion of the stage of the sexual cycle. These investigators confirmed in all essential points our previous results, though they do not mention our principal paper in which we gave a detailed description of the uterine cyclic changes in the guinea-pig. This omission, Dr. Stockard informed me later, was due to his failure to read my paper.

The difference in the duration of the sexual cycle in our first and second series of experiments led to a further elucidation of the factors on which the mechanism of the sexual cycle depends. We found that the presence of experimentally produced deciduomata without accompanying pregnancy prolongs the duration of the sexual cycle, but only in cases in which the corpora lutea are present. After extirpation of the corpora lutea an accelerated ovulation takes place notwithstanding the presence of living deciduomata; the deciduomata act, therefore, in a way similar to pregnancy. We found furthermore that after degeneration of the deciduomata ovulation occurs. We may therefore conclude that living deciduomata probably prolong the life of the corpora lutea and that this effect leads to a

[8] Leo Loeb, *Biological Bulletin*, 1914, XXVII., p. 1.

[9] Charles R. Stockard and G. N. Papanicolaou, *Am. Jour. Anatomy*, 1917, XXII., p. 225.

prolongation of the sexual cycle. It may be that also in pregnancy the decidua may contribute directly to the prolonged life of the corpora lutea and thus indirectly be responsible for the lack of ovulation during the period of gestation. We found further that during pregnancy the life of experimental deciduomata is prolonged very considerably, and we may provisionally assume that directly or indirectly the presence of an embryo is responsible for the preservation of deciduomata during pregnancy. It accords with these observations that in a case of experimentally produced extrauterine pregnancy in which a living embryo, but no decidua was present, we did not find the life of the corpus luteum prolonged, and consequently an ovulation had taken place despite the presence of a living embryo.[10] In a provisional way we may therefore assume that the life of the corpus luteum, which is one of the determiners of the duration of the sexual cycle, depends among other factors upon the life of the deciduomata or decidua and that the latter depends upon the existence of a living embryo. We have carried out a series of experiments concerning this question several years ago, but stress of other work has so far prevented a detailed study of our results. However, we referred to them in a preliminary way in a recent communication dealing with those problems.

We have now to consider briefly the reason why it is that while we can consider as firmly established the significance of the corpus luteum for the sexual cycle, injections of dried corpus luteum substance are without a decided effect on ovulation, and likewise without effect on the growth of the mammary gland in the guinea-pig, as we established more recently. We can not answer this question definitely at the present time, but we can at least consider certain possibilities and refer to some interesting analogies. It might be that the isolated lipoid extract of the corpus luteum would have been active where we established the lack of efficiency in dried gland from which, as was the case in Armour's preparation, the lipoids had been previously removed. This would be in accordance with the observation made by several investigators who found that injection of lipoid extracts of corpus luteum or placenta causes growth processes in the uterus and mammary gland. However, these induced growth processes are evidently not identical with the cyclic changes normally taking place in these organs. Or it might be that the process of drying destroyed the active principle. Thus we know that while suspension of living cells when injected produce immunity against tumor growth in the mouse, cells which have been previously treated in a way similar to the treatment accorded to the corpus luteum and thus killed, have completely lost their efficiency. We know furthermore, that the antigens against mouse tumors are species specific; on the whole only tissues of the mouse are able to immunize against mouse tumors; tissues of the cow for instance being completely inert. We can not therefore exclude the possibility that extracts prepared from homologous corpora lutea might have been more efficient than those from the cow.

There remains a last possibility which I suggested a number of years ago when I found that a substance given off by the corpus luteum is one of the factors of significance in initiating the decidual reaction and the development of deciduomata in the uterus. At that time I tried to imitate the effect of the corpus luteum on the mucosa of the uterus through implantation of living young corpora lutea obtained from other guinea-pigs in the appropriate stage of the sexual cycle. The implantation of this substance gave either entirely negative results or at least its effects were very weak. I then pointed out that the corpus luteum functions by giving off a small amount of substance continuously during a relatively long period of time, while injection or implantation of corpus luteum substance leads only to the temporary introduction of a larger quantity which is probably rapidly absorbed and eliminated or destroyed, and that it is impossible to imitate in this way the action which takes place in nature.

While we can not be certain at the present

[10] Leo Loeb, *Biological Bulletin*, 1915, XXVIII., p. 59.

time as to which of these explanations will prove to be the correct one, we can at least be certain that the living corpus luteum has the function of inhibiting ovulation and of being a decisive factor in the mechanism of the sexual cycle.

Leo Loeb

Department of Comparative Pathology, Washington University Medical School

---

THE OHIO ACADEMY OF SCIENCE

The twenty-eighth annual meeting of the Ohio Academy of Science was held at Ohio State University, Columbus, May 30 to June 1, 1918, under the presidency of Professor Francis L. Landacre. Forty-seven members were registered as in attendance; ten new members were elected.

It was reported by the trustees that Mr. Emerson McMillin, of New York City, had again contributed two hundred and fifty dollars to the research fund of the academy.

War conditions were noticeable in a somewhat reduced attendance, as well as in a suggestion of the trustees that a part of the research fund be invested in Liberty Bonds—a suggestion enthusiastically endorsed by the academy.

The following resolution was also adopted, relative to the study of German in the colleges:

> The Ohio Academy of Science places itself on record as deprecating the suppression of the study of the German language in the curricula of some of our colleges.
>
> The study of German should be continued not only by reason of its direct utility to our troops abroad, but also because it is fundamentally necessary to science and productive scholarship.
>
> It is not the language, but Prussian ideas, which are antagonistic to the Allied nations; and any action which prevents the efficient development of scholarship and science, and of the industries dependent upon them, will prove advantageous to our enemies.

After adjournment of the formal sessions, the botanists and zoologists made a short auto excursion to the picturesque and ecologically interesting Sugar Grove region, and the geologists took a longer trip for the study of the rock series (Niagara to Carboniferous) and topography between Hillsboro and the Scioto River. Both excursions were eminently successful.

Officers were elected as follows: *President*, M. M. Metcalf, Oberlin College. *Vice-presidents:* Zoology, R. A. Budington, Oberlin College; Botany, C. E. O'Neal, Ohio Wesleyan University; Geology, G. F. Lamb, Mt. Union College; Physics, S. R. Williams, Oberlin College; Medical Sciences, Ernest Scott, Ohio State University. *Secretary*, E. L. Rice, Ohio Wesleyan University. *Treasurer*, J. S. Hine, Ohio State University.

The scientific program was as follows:

PRESIDENTIAL ADDRESS

The origin of the cerebral ganglia of the vertebrates: Professor F. L. Landacre, Ohio State University.

SYMPOSIUM ON SCIENCE AND THE WAR

The work of the ground schools in the training of the air forces of the United States: Professor F. C. Blake, Ohio State University.

Modern methods of plant disease control: Professor W. G. Stover, Ohio State University.

Psychological tests in the army: Captain George F. Arps, Ohio State University.

Methods of teaching the theory of flight in schools of aeronautics: Professor H. C. Lord, Ohio State University.

Topography and the war on the western front: Professor T. M. Hills, Ohio State University.

The newer demands on physics and physics teachers due to the war: Professor E. H. Johnson, Kenyon College.

PAPERS

A peculiar habit of the rusty grackle: Edward L. Rice.

Notes on distribution of North Atlantic Bryozoa: Raymond C. Osburn.

Economic value of the Ephemerida: Chas. P. Fox.

Remarks on leaf hoppers of Hawaiian Islands: Herbert Osborn.

The fauna of a series of rock-bottomed ponds: F. H. Krecker.

The habits of the folding-door spiders: W. M. Barrows.

The subterranean life of meadows and pastures: Herbert Osborn.

Opalina and the origin of the Ciliata: Maynard M. Metcalf.

The bryozoan gizzard: Raymond C. Osburn.

Free-swimming larval colonies of Pectinatella from Black Channel, Cedar Point: Stephen R. Williams.

Anatomy of Echinorhynchus sp.: C. F. McKhann, Jr., introduced by Stephen R. Williams.

The effect of certain ductless gland extracts on plant tissues: R. A. Budington.

Our knowledge of Ohio Crustacea: Raymond C. Osburn.

A list of Ohio spiders (now in press): W. M. Barrows.

A preliminary survey of the Protozoa of Mirror Lake on the Ohio State University campus: Mabel E. Stehle.

Application of colloid chemistry to nephritis: Hazel C. Cameron.

Reaction time in the blind and the deaf: A. M. Bleile.

The effect of radium radiations on the germ cells of Drosophila ampelophila: W. M. Barrows.

Studies on vaso-motor balance: Clyde Brooks, Clayton McPeek and R. J. Seymour.

Note on the catalase content of the turtle heart: R. J. Seymour.

Pneumococcus types: Carl L. Spohr.

The cancer problem: Ernest Scott.

Behavior of the X-chromosomes in Branchipus vernalis: R. C. Baker.

Work of the Plant Disease Survey, U. S. D. A., in Ohio: A. D. Selby.

Characteristics of the eruption of Katmai as indicated by its effect on vegetation: Robert F. Griggs.

The Lecideaceæ of Ohio: Bruce Fink.

Interesting ascomycetes: Bruce Fink.

A revised course for secondary botany: Blanche McAvoy.

Inland associations of algæ: E. N. Transeau.

Regeneration studies of Bryophyllum: Charles W. McIntyre.

Effect of hairy coverings on transpiration: Jasper D. Sayre.

Succession of prairies: Homer C. Sampson.

Effect of seed treatment for smut on germination: Wilmer G. Stover.

The indicator significance of plant associations in crop distribution in the United States: Adolph Waller.

Vegetative reproduction of the pinnatifid spleenwort: Clara G. Mark.

An apple root fungous disease: Harry W. Lutz.

An electric drying oven for plant presses: E. Lucy Braun.

Some land forms of central southern Ohio: Lewis G. Westgate.

Fossils of the Greenfield (Ohio) dolomite and where to find them: C. W. Napper.

Moulding sands of Ohio: J. A. Bownocker.

Effects of the Wisconsin glacier on a portion of the Whitewater valley in Indiana: W. M. Tucker.

Some especially interesting new species of Richmond fossils: W. H. Shideler.

Effect of transverse magnetic field on some of the physical properties of nickel wire: A. A. Atkinson.

The magnetic-mechanical analysis of cast iron: Samuel R. Williams.

DEMONSTRATIONS

Specimen of a dermoid cyst with teeth, loaned by Dr. H. Moore, Oxford: Stephen R. Williams.

Leaf hoppers of Hawaiian Islands: Herbert Osborn.

One-eyed frog (Acris gryllus): F. H. Krecker.

Laboratory table tray: F. H. Krecker and W. J. Kostir.

Colony forms in marine Bryozoa: Raymond C. Osburn.

Exhibit of Greenfield (Ohio) Dolomite fossils: C. W. Napper.

Two new varieties of Acer rubrum: Freda Detmers.

A collection of Ohio spiders; a method of exhibiting spiders; nest of folding-door spider: W. M. Barrows.

A vaso-motor balance: Clyde Brooks, Clayton McPeek, R. J. Seymour.

Models of embryonic skull of Eumeces: Edward L. Rice.

Sections of nasal capsule and olfactory nerves of embryonic Cumeces: Edward L. Rice.

X-chromosomes of Branchipus vernalis: R. C. Baker.

Origin of cartilage from ectoderm in the urodeles: F. L. Landacre.

Specimens and photographs from the Valley of Ten Thousand Smokes: Robert F. Griggs.

Edward L. Rice,
Secretary

Delaware, Ohio

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, SEPTEMBER 20, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

PLANS FOR A HISTORY OF MATHEMATICS IN THE NINETEENTH CENTURY[1]

MY distinguished predecessor in the presidency of this association at one time ingeniously concocted a plan of procedure which if adopted, would have enabled him and succeeding presidents to escape the ordeal of preparing a presidential address. As a member of the council, I greatly enjoyed cooperating with others in nipping the president's scheme in the bud. Little did I know at that time that I was working against my own best interests and against the pleasure and comfort of the association on the present occasion.

An address being expected, it is my intention briefly to discuss plans of an organized movement for the writing of the history of mathematics of the nineteenth century on a scale commensurate with what has been achieved for previous periods. Taking for granted that such a history is desirable, in order that the present age may apprehend itself by comprehending its origin and growth, three important questions present themselves for consideration: Is it possible so early in the present century to write a satisfactory history of the preceding century? What will be the magnitude of the task, as compared with the labor involved in writing the earlier history? What should be the aim and nature of such a history?

As regards the first question, the material for the writing of modern scientific history is quite easily accessible. In this respect the writer of the history of science enjoys a great advantage over the writer of the history of recent diplomacy or war. Nor are the feelings and prejudices as intense on matters of

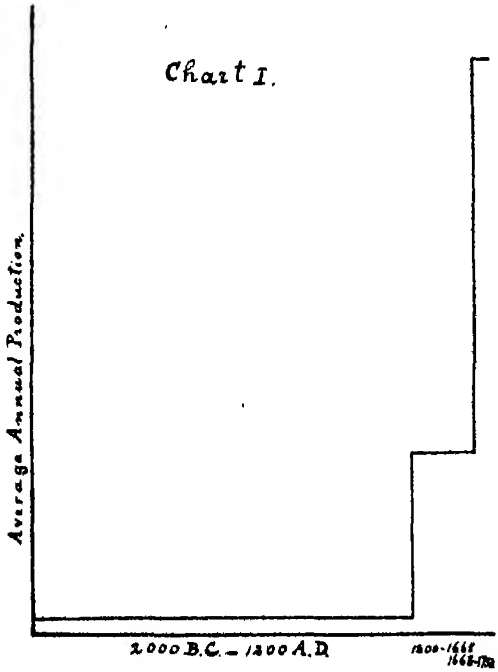
[1] Address delivered by Professor Florian Cajori as retiring president of the Mathematical Association of America, at Dartmouth College, on Saturday, September 7, 1918.

science as they are in religion, or in wars which involve the life and death of individuals and of nations. But, even if we have the material at hand, is it possible to write the mathematical history of the nineteenth century at this early date? Do we not now lack the proper perspective? In reply, we admit at once that we can not now write a history which will satisfy mathematicians seventy-five or one hundred years hence. All we can hope to do is to render a service to the present and the next generation of mathematical students and investigators. Nor can the history of the nineteenth century be written seventy-five or a hundred years from now in a manner that will be fully acceptable to all posterity. The general proposition holds true that no decade can write history which does not have to be rewritten later; no decade can write history for all future decades. There is an inevitable relativity of historical narrative. The reason for this relativity is obvious. The point of view changes; the attention of mathematicians will be directed to new concepts. Part of the history of mathematics will have to be rewritten in order to give proper emphasis to these new concepts. If it were possible, after the lapse of a few centuries, to impart finality to a history, then assuredly the history of Greek mathematics should have been rigidly determined and fixed long ago. But the facts disclose no such finality. In recent years the history of Greek mathematics has been partly recast. Zeno of Elea, whose arguments on motion formerly received little or no attention from mathematicians and were completely ignored by Montucla, the great eighteenth century historian of mathematics—this Zeno who was berated by philosophical writers as an insincere dialectician or as the progenitor of modern pettifogging lawyers—has been interpreted by Paul Tannery and other recent historians as having dealt sincerely and ably with questions of infinity now playing a leading rôle in modern mathematics. Geometric ideas of the last fifty years have brought into prominence the postulate of Eudoxus and Archimedes which the older historians of mathematics passed over in silence. The advent of the non-Euclidean geometry has thrown Euclid's parallel postulate into a wholly different light. Euclid's once criticized definition of equal ratios as contained in the fifth book of his Elements acquires a fresh interest when seen in the light of Dedekind's theory of the irrational. Many other illustrations might be cited to prove that historical narrative is relative, that history can not be written by a historian of one age, however keen, to satisfy all succeeding ages. Since this is so, should historians in despair drop their pens, remain idle and permit mathematicians to labor without the stimulus and light which a history of the modern developments of their science can give? Assuredly, no. A history of nineteenth century mathematics can be written acceptably to workers of to-day and to morrow, but will probably be in need of revision on the day after to-morrow. To wait for the moment when a history of mathematics can be written that will answer the demands of all future time is to postpone the crossing of a great river until all the water has flowed by.

An important step is the ascertainment of the magnitude of the task, the determination of the volume of mathematical literature to be penetrated. For purposes of comparison we have found it convenient to consider the mathematical productiveness during seven periods. Moritz Cantor's four volumes of lectures on the history of mathematics furnish the data for the first four periods. Statistics which I gathered from the first three volumes of Poggendorff's "Biographisches Handwörterbuch" were used to characterize the next two periods, while Professor H. S. White's "Forty Years' Fluctuations in Mathematical Research"[2] that took place since 1870 furnished the figures for the last period. Cantor's first volume gives the history of about 32 centuries down to 1200 A.D.; the second volume covers 468 years, to 1668; the third volume gives the history during 90 years, to 1758; while the fourth volume is limited to 41 years and carries the history down to 1799. We shall assume that the sizes of the volumes are ap-

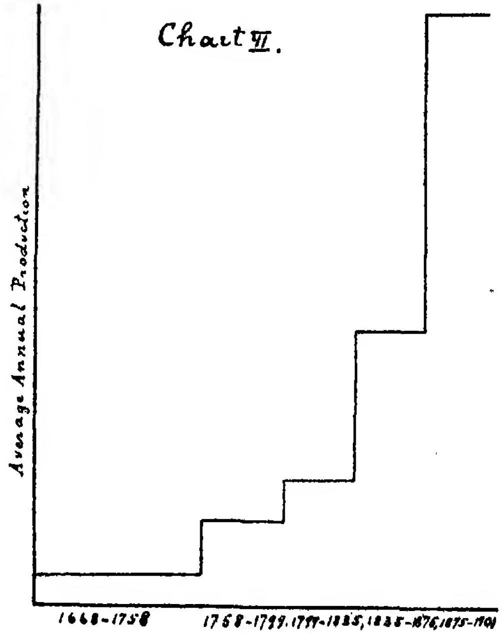
[2] SCIENCE, N. S., Vol. 42, 1915, pp. 105–113.

proximately proportional to the mathematical output of the periods covered. In Chart I., letting a short ordinate represent the average annual mathematical production during the first period extending from antiquity to 1200



A.D., we find that the average yearly production for the second period of 468 years is 6.9 times greater than for the first period, and for the third period of 90 years, 35.3 times greater. It will be convenient to take the average annual output during the first period as a unit measure of mathematical production. Accordingly, the figures for the first three periods are per annum, respectively, 1, 6.9, 35.3.

That we may graph more conveniently the expansion of mathematical literature since 1758, the third period is represented in Chart II. by a short ordinate. The fourth period of 41 years shows that the annual publications are 2.7 times more voluminous than those of the third period, indicating a yearly production of 95.8. To carry the comparison down to later periods I counted the number of mathematical writers given in the first two volumes of Poggendorff's "Handwörterbuch" for the eleven years 1790–1800. I found this number to be 244. For the period 1830–1840 I obtained 341 names. This indicates an increase in the ratio 1.398. I also counted the number of lines taken up in the enumeration of titles of books and articles of 134 mathematical writers for 1790–1800 and of 134 mathematical writers for 1830–1840. I began at random with the name of Jolly and in succession took the names of mathematical authors who wrote during these intervals. By this test the average productiveness of the individuals of these two groups proved, to my surprise, to be nearly the same; it was in the ratio of 1 : 1.04 in favor of the later group.



Combining the ratios of 1.398 and 1.04 I get 1.45 as the rate of increase in volume of mathematical literature of the period 1830–1840 over that of 1790–1800. The gradient fixed by the middle points of the third and fourth periods in Chart II. indicates for 1799 an approximate production of 114.4. Multiplying 114.4 by 1.45 gives 165.9 as the production for the year 1835. The average of 114.4 and 165.9, or 140.1 is the average annual production during the fifth period.

For the eleven years 1870–1880 I found in the third volume of Poggendorff 888 names

of mathematical writers; this number is 2.6 times greater than that for 1830–1840, indicating an annual production of 2.6 times 165.9 or 431.3. The average annual production for the sixth period 1835–1875, is the average of 165.9 and 431.3, or 298.6.

From Professor White's statistics it appears that the annual output was in 1905 about 2.1 times greater than in 1875, or 905.8. From these data it follows that during the seventh period, 1875–1905, the average yearly quantity of mathematical literature was 668.8. Our results, put in tabular form, are as follows:

	Average Annual Production	Production during Period
I. Period, 2000 B.C.–1200 A.D.	1	3,200
II. Period, 1200–1668	6.9	3,149
III. Period, 1668–1758	35.3	3,177
IV. Period, 1758–1799	95.8	3,928
V. Period, 1799–1835	140.1	5,044
VI. Period, 1835–1875	298.6	11,944
VII. Period, 1875–1905	668.8	20,064

The tremendous increase is shown strikingly also by the two charts. They give emphasis to the biblical declaration, "Of making many books there is no end."

The total literary production during the last three periods is 37,052 and for the interval 1799–1901 it is 34,377. How long would it take to survey this field and write the history of mathematics of the nineteenth century? Moritz Cantor published his first historical paper in 1856 and completed the third volume of his well-known history in 1898. Perhaps it would not be fair to claim that all of these 42 years were given to the three volumes. Three smaller historical books from his pen preceded the three volumes in question. The early years were years of necessary preparation. The first volume appeared in 1880, the second in 1892, or 12 years later. If we assume that the preparation of the first volume required the same time as that of the second, then 30 years is the time Cantor devoted to the three volumes. In the tabular view given above the first three volumes are the history covering mathematical material amounting to 9,526. At this rate it would take a man 108.3 years, or 20 men 5.4 years, to write the history of mathematics of the nineteenth century, provided that these men gave, as did Cantor, a liberal amount of time to research and confined their efforts to this particular project. If only one third of their research time were given to it, then 65 men would be needed for 5 years.

Let us estimate the number of men from a different set of data. Volume IV. of Cantor's history was prepared by 10 men, each working about one year and a half. Some of these prepared short chapters and probably completed their parts in less time. On the basis of 1½ years and on the supposition that each worker will give one third of his research time to the enterprise, it will take 79 men 5 years to write the mathematical history of the nineteenth century. If this history is written with the elaborateness of Cantor's "Vorlesungen," it will embrace 14 or 15 volumes of the size of the Cantor volumes; it will contain 5½ million words. Probably it would be wise to plan a considerably smaller number of volumes.

Considering the magnitude and difficulty of the undertaking, it is quite evident that American mathematicians alone would find the task excessive. If the services of English, French and Italian mathematicians could be enlisted, the enterprise would be comparatively easy. In past years it has been Europe that has initiated organized efforts among scientists. In proof of this I need only mention the "Encyklopädie der mathematischen Wissenschaften," the "Encyclopédie des sciences mathématiques," the "Royal Society Catalogue of Scientific Papers," as also the publications of Euler's complete works, of the *Fortschritte der Mathematik*, of the *Revue semestrielle*. It would seem to be our turn to take the initiative. The history of mathematics of the nineteenth century might very well be planned and financed by America. The magnitude and difficulty of the task would exert a healthful stimulus upon our 550 colleges and universities. Such an ambitious scheme would require the exercise of energies now latent.

Let us hope that the places where mathematical research is carried on will cease to be limited to a small number of localities on the

great map of our country—the seats of our stronger universities. The spirit of research should penetrate many other institutions. Young men of ability, now doomed to pass their lives with broken wings through the crushing weight of excessive hours of teaching, should find relief in the future and be encouraged to accomplish the highest that is in them to do. Professor Bjerknes, of Stockholm, when lecturing at Columbia University, ventured the statement that had his teaching schedule at home been as onerous as is that of American professors, then he would never have been invited to lecture in America in a difficult branch of science.

To carry the enterprise we are considering into successful operation calls for the united efforts of three groups of men: The mathematician, eager to enter a rich but difficult field of research, the administrator, willing to provide the mathematician with the necessary leisure, and the philanthropist, ready to supply the funds necessary for the publication of the results of research. Has America the ideals and the genius of organization for the creation of such a triumvirate?

In recent years a new ideal for the history of mathematics has arisen. The new movement calls for a much more careful and comprehensive scrutiny of historical material; it demands higher standards of historical accuracy. This ideal has been championed in the *Bibliotheca Mathematica*, a journal edited by Gustav Eneström, of Stockholm. According to the standards set by Eneström, the labors of Moritz Cantor, of Heidelberg, especially the third volume of his well-known history, hardly reach the high mark of excellence demanded. Cantor worked diligently and persistently for many years until finally failing eyesight lessened his powers and, more recently, compelled him to enter the darkened universe of the blind. If his third volume is inferior to his first two, an additional cause thereof is found in the fact that in the seventeenth and eighteenth centuries so many new mathematical subjects were introduced that the task of setting forth their history almost transcended the powers of a single individual. Necessity compelled the fourth volume to be prepared on the cooperative plan, by a group of men.

The present danger is that, in the effort to attain extreme accuracy in historical detail, we shall lose sight of literary quality. The publications of Huxley and Tyndall have demonstrated that scientific writing admits of combination with literary finish. The two ideals are not incompatible. Good literary form challenges attention and provokes admiration. Macaulay, the great master of words, made history enjoyable to thousands who otherwise would have shunned historical reading. Arago's biographies of scientific men have a charm their own.

In order to make the history of mathematics interesting, it is desirable to consider not only literary finish, but also the amplitude of topics selected. In writing the mathematical history of the nineteenth century, it does not seem to me sufficient merely to endeavor to trace the line of scientific progress, the evolution of new concepts. That much is done by the "Encyklopädie" and the "Encyclopédie," which we hope may be carried to completion soon after the termination of the great war. The mathematical reader does not subsist on logic alone. He is eager for color. He desires to know the personality of great mathematicians, the environment in which they worked, their idiosyncracies, their struggles with scientific difficulties, the circuitous route by which they reached their results, the influence which mathematicians exerted, one upon another. The heroism of some scientific men makes a tremendous appeal to the reader. These topics create not only interest but enthusiasm. In fact, if we consult our experience, as well as that of others, we are forced to admit that the best that we have from history is the enhusiasm which it generates. The mathematician, like the warrior, is a hero worshipper. In the case of Archimedes, the reader expects the historian not only to state accurately the connection of the writings of Archimedes with those of his predecessors, the advances that he made and the relations that his writings bear to the modern mathematics,

but the reader expects also a presentation in vivid style of the imagination and enthusiasm that Archimedes exhibited in the saying "Give me a fulcrum on which to rest, and I will move the earth;" the reader likes to be entertained by the narrative of his behavior when the true solution of the problem of the crown flashed on his mind—how he jumped out of his bath and shouted "I have found it"; the reader likes to be able to cite as marks of high patriotism his services to his sovereign in the construction of war engines and his alleged use of reflecting mirrors to set the Roman ships afire; the reader wishes to be reminded of the tragic death of Archimedes at the hands of a Roman soldier whom he had requested not to spoil his circles drawn in the sand, of his desire that the figure for his theorem on the sphere and circumscribed cylinder be inscribed upon his tomb, and how, over a century later, Cicero found the tomb of this the greatest mathematician of antiquity almost hidden amongst briars near one of the gates of Syracuse and forgotten by the people of the city.

Details of this sort do not strictly belong to a history of scientific ideas, but they add color to the narrative. Like all men, the mathematical reader is largely dominated by feeling. A modern poet has said of Horace,

> It is a curse
> To understand, not feel thy lyric flow,
> To comprehend, but never love thy verse.

Where is the science which appeals to the intellect alone, never to the heart? Such a science, if it exists at all, can not be found in the camp of the mathematicians. Certainly, then, the history of mathematics should appeal to the heart as well as to the head. Such a history should create respect and love for mathematics; it should excite admiration for this science; it should make the mathematician feel stronger than ever that he is contributing his bit toward the true grandeur of nations.

Florian Cajori

University of California

THE BRITISH NATIONAL PHYSICAL LABORATORY

The National Physical Laboratory is now conducted as a government institution under the financial control of the Committee for Scientific and Industrial Research, though its scientific work and researches remain under the direction of the Royal Society as before, and its annual report, of which the London *Times* gives an abstract, is for the first time published by the Stationery Office (2s. 6d. n.). As has been the case since 1914, a large part of the laboratory's work last year was in connection with the requirements of the war, and therefore can not be described in detail, even if referred to at all, but there is a considerable body of investigations to which this limitation does not apply.

In the electrical department additional magnetograph 24-hour records were taken and coincidences found between the running of electric trains on the London and South-Western Railway and magnetic disturbances at the laboratory. The question as to the magnitude and cause of certain of the disturbances was submitted to the arbitration of Mr. A. J. Walter, K.C., in November and December, and he adjudged that the use of electrical power by the railway has caused an increase in the horizontal magnetic field at the laboratory to an extent exceeding that stipulated in the South-Western Railway Act of 1913.

Among general electrical measurements a large number of the small mica condensers used in magnetos were tested for capacity and power factor; much work was done in connection with the composition and treatment of steel used for compass needles, and some special search coils proved valuable in testing permanent horse-shoe magnets. Some investigation was also made of the properties of non-magnetic steels. Sensitive vibration galvanometers for frequencies of the order of 10 cycles were constructed, and some preparations made for a research on effective resistance at radio frequencies. A new 400-volt secondary battery is being installed for use with large valves to generate the high-frequency current.

In the division of electrotechnics, in view of

the fact that large gas-filled lamps cause considerable heating of the lamp sockets used with them, owing to conduction of heat from the bulbs, measurements were made of the temperature rise of ventilated and unventilated sockets, and of the leading-in cables when used in lanterns of both the open and the enclosed types. It was found that the cables were liable to a total temperature of about 140° C., and that little improvement resulted from the use of existing arrangements for socket ventilation.

Good progress was made with the research on buried cables. The electrical constants of all the cables under test were determined, and it was found that in general the rise of temperature of a cable drawn into a stoneware duct was twice that of a similar cable armored and laid direct in the ground, cables laid solid in bitumen occupying an intermediate position. Other points, such as the length of time required by the cables to attain their maximum temperature, the effect of the ends, and the temperature gradient in the duct and in the cable, were also dealt with. The design of the special motor-generator set which will be used to supply continuous current for the cables, and which will also be used for heavy test work, has been settled and the machine is under construction. It consists of two continuous-current generators, each fitted with two commutators. Each commutator is arranged for a current of 1,250 ampères at 6 volts, the ends being brought to a series-paralleling board. By this means currents up to 1,250 ampères at 24 volts will be available for the cable tests and up to 5,000 ampères at 6 volts for the test work, suitable regulation to any required current being obtained by resistances in the exciting circuits. The generators, which will be driven by a three-phase 3,000-volt motor running off the town supply, will be separately excited, the excitation current being maintained constant by a centrifugal spring regulator putting resistance into or out of the field of the motor.

The heat division collaborated with the Heating and Cooking Panel of the Engineering Standards Association in developing efficiency tests for electrical plates and cooking stoves. A number of pyrometer sheaths of British manufacture were tested for their softening point and porosity at high temperature. Some of the samples of porcelain, though unglazed, stood the porosity test remarkably well; in fact, when the interior was exhausted to a pressure of a few millimeters of mercury the walls collapsed under the external pressure before any leakage occurred. On the other hand, tubes of fireclay and shrunk alumina often showed a return to atmospheric pressure in about 10 seconds. A large series of aluminium alloys was investigated for thermal conductivity on behalf of the Light Alloys Sub-committee of the Advisory Committee for Aeronautics, the advantages of such alloys, on account of their high conductivity, for the construction of the cylinders and pistons of aero engines having been appreciated for some time. It was evident at the outset that measurements at room temperature would not be sufficient, since the temperatures encountered in actual practise range up to 300° C., and an absolute and expeditious method of determining thermal conductivity and its variation with temperature was therefore devised.

In Metrology the year was distinguished by the development of the gauge-testing work. The new gauge-testing building was completed in May, and occupied in the early part of June. The numbers dealt with, however, continued to increase and at the end of 1917 were more than double those of 1916. There was a steady increase in the quantity of screw gauges tested, but in the first three months of this year there was a considerable reduction in gauges of the more simple types. The types that continue to be received are, however, in general more complicated and involve more work in testing than those which have dropped out. The gauge-rectifying shop was found much too small to meet the demands made upon it, and the erection of a new workshop of 10,000 square feet area was sanctioned. The building of this has been started.

Arrangements have been made for the calibration of glass volumetric apparatus. Accom-

modation for the work will be provided in a new three-story building to be erected alongside the Administration Building, but meantime a house close to the laboratory entrance is being equipped temporarily for the purpose.

A watch sent for testing by Paul Ditisheim, La Chaux de Fonds, Switzerland, obtained 96.2 marks out of a possible 100—the highest total yet recorded in the Kew trials.

The investigations of the methods of notched bar impact testing were continued, and in the present year it is proposed to inquire into the following questions: Need for test bars of different sizes; the question of test bars supported at two ends or fixed at one end; how far the work of fracture depends on the cross-section or the volume of the test bar, or both, and whether a relation can be found for reducing results on one size of bar to those on another; influence of the velocity of striking and angle of bend of the bar; and application of notched bar tests to carbon steels in industrial products. The hardness test research is being extended to cover the effect of the wear caused by sliding abrasion, of variations in the relative velocity of the surfaces, and of the pressure between them. The Brinell ball test, usually adopted for indicating the indentation hardness of a material, is open to the objection that it varies with the load and with the hardness of ball used. Hence a standard ball of 10 mm. diameter and a fixed load of 3,000 kg. are employed, but it is not always possible to use this standard—*e. g.*, with very thin test pieces or very soft materials. Experiments have therefore been made with the object of studying the various methods of bringing results obtained with different balls and loads into line with those obtained by using the standard.

The experiments with the apparatus described in last year's report for determining the heat transmission to water from the internal surfaces of brass pipes, smooth and roughened, were completed. The results showed that, with the amount of roughening obtained, the heat transmission per unit surface per degree in difference of temperature between metal and water for the smooth pipe could be increased in the ratio of about 2.5 to 1 for the same mean velocity of flow. It was obvious that if improvements of this order could be made in the surfaces of air-cooled engines and radiators, considerable economy of material could be effected in aeroplane engine design. To test the question a series of copper gills of the form and distribution commonly adopted in air-cooled engines was fixed to the cylinder of the engine and set up in a wind channel. An electric current was then circulated through the gills, and from measurements of the current and resistance it was possible to ascertain the temperature of the gills and the heat dissipated. The gills were first tested in their ordinary smooth condition and then roughened by means of corrugated steel dies. The roughening, however, appeared to produce practically no effect on the heat transmission, this result indicating that the convection of momentum to the rough and smooth surfaces was approximately the same. The reason for this apparent discrepancy between the two sets of observations is still under investigation.

The demands of the Aerodynamics Department are so numerous and important that the erection of two new air channels has been called for. A new airscreen balance for the 7 foot tunnel is in hand and a new apparatus for lift measurement is in use. Modified apparatus for the measurement of rotary derivatives was devised and will be further developed.

The research work carried out was of the most varied character. Tests were made on models of aeroplane wings, monoplane and biplane models of complete aeroplanes, airships and kite balloon models, and models of airscrews, with calculations relating to stability, strength of construction, bomb-dropping, etc. A large amount of work was done in connection with the design of wind channels, and the research on eddy motion was continued. Many of the investigations were made in response to direct requests from the Air Ministry, but every effort was made to increase the value of special tests by bringing them into proper relation as part of an organized scheme of research.

Such increase in equipment as was made in the Metallurgy Department arose chiefly in connection with the extension of foundry facilities urgently needed for the work on light alloys and on optical glass. The investigation on aluminium and other light alloys was energetically pursued and was devoted to the immediate requirements of aircraft construction. A considerable amount of theoretical investigation was also carried on, leading to the establishment of a number of constitutional models of ternary alloys of aluminium with other metals. A number of important practical questions were thus cleared up, among them being the explanation of the various forms in which silicon is found analytically in aluminium alloys and the bearing of these results on the properties of the materials. Other researches had for their object the elucidation of apparently anomalous behavior in various groups of aluminium alloys. The nature and constitution of the more important ternary alloys and the influence of impurities on them were investigated, with the result that these relationships are now much better understood.

A large amount of research and investigatory test work was carried out on steel. Some of the results obtained seem to be of wide importance in regard to the treatment to which particularly thick boiler plates can be safely subjected. Research on magnetic steels was actively continued. Investigation was begun of a set of specially made tungsten steels of graded composition, received from Messrs. Thomas Firth and Sons, but it was found necessary to adopt better methods of magnetic measurement than were used in the earlier stages of the work, and special arrangements were also made for carrying out thermal observations of these steels in a more satisfactory manner. A number of discrepancies were revealed, believed to arise from the influence which antecedent thermal and mechanical treatment of the steel exercises on its subsquent magnetic behavior. To clear up these questions, which are of vital importance in the production of satisfactory magnets, and which involve questions affecting steels other than the particular tungsten alloys under investigation, a special research was initiated for the study of the constitutional relations of iron-carbon-tungsten within the range of alloys concerned.

The work in connection with the proposed issue of standardized steel samples to serve as standards for the chemical analysis of steels was carried forward in conjunction with a committee of the Iron and Steel Institute, but was hampered by existing conditions. It is hoped however, that the issue of standardized samples may become possible shortly.

As regards optical glass a large amount of work was done in preparing pots or crucibles of special refractory materials that do not lend themselves to treatment by ordinary methods. Methods of melting and stirring glass were further investigated by means of experimental meltings, some of which gave results of great promise.

The testing of ship models for firms in the experimental tank was affected in two ways. First, the building of fast and intermediate liners being in temporary abeyance, there was no demand for model work with those types of vessel. Second, the introduction of standard vessels must result in the suppression of individuality in the forms adopted by different builders, and the model results for one firm will apply to all vessels of the type, no matter where built. It is therefore the more important that steps should be taken to ensure that whatever forms are adopted as standard shall be good ones. Private firms have recognized this, and about half the vessels tested for firms during the year were in connection with standardization. The best result obtained was a reduction of 13 per cent. in resistance without any variation of displacement or dimensions, or diminution of working qualities such as stability. Apart from tests for private firms a number of models of standard cargo vessels were made and tested for the Admiralty and others. There were a number of tests with straight line forms of fabricated ships, and the satisfactory results obtained must lead to an extension of the use of this type if it is found to be constructionally acceptable.

SCIENTIFIC EVENTS

THE STUDENTS' ARMY TRAINING CORPS

In a letter from the War Department addressed to the colleges of the United States, August 28, 1918, the general plans under which the Students' Army Training Corps will operate this year were outlined. Among the most important statements were the following:

1. All young men, who were planning to go to school this fall, should carry out their plans and do so. Each should go to the college of his choice, matriculate and enter as a regular student. He will, of course, also register with his local board on the registration day set by the President. As soon as possible after registration day, probably on or about October first, opportunity will be given for all the regularly-enrolled students to be inducted into the Students' Army Training Corps at the schools where they are in attendance. Thus the Corps will be organized by voluntary induction under the Selective Service Act, instead of by enlistment as previously contemplated.

The student, by voluntary induction, becomes a soldier in the United States Army, uniformed, subject to military discipline and with the pay of a private. They will simultaneously be placed on full active duty and contracts will be made as soon as possible, with the colleges for the housing, subsistence and instruction of the student soldiers.

2. Officers, uniforms, rifles and such other equipment as may be available will be furnished by the War Department, as previously announced.

3. The student-soldiers will be given military instruction under officers of the Army and will be kept under observation and test to determine their qualification as officer-candidates, and technical experts such as engineers, chemists and doctors. After a certain period, the men will be selected according to their performance, and assigned to military duty in one of the following ways:

(*a*) He may be transferred to a central officers' training camp.

(*b*) He may be transferred to a non-commissioned officers' training school.

(*c*) He may be assigned to the school where he is enrolled for further intensive work in a specified line for a limited specified time.

(*d*) He may be assigned to the vocational training section of the corps for technician training of military value.

(*e*) He may be transferred to a cantonment for duty with troops as a private.

4. Similar sorting and reassignment of the men will be made at periodical intervals, as the requirements of the service demand. It can not be now definitely stated how long a particular student will remain at college. This will depend on the requirements of the mobilization and the age group to which he belongs. In order to keep the unit at adequate strength, men will be admitted from secondary schools or transferred from Depot Brigades as the need may require.

5. No units of the Students' Army Training Corps will, for the present, be established at secondary schools, but it is hoped to provide at an early date for the extension of military instruction in such schools. The secondary schools are urged to intensify their instruction so that young men seventeen and eighteen years old may be qualified to enter college as promptly as possible.

6. There will be both a collegiate section and vocational section of the Students' Army Training Corps. Young men of draft age of grammar school education will be given opportunity to enter the vocational section of the corps. At present about 27,500 men are called for this section each month. Application for voluntary induction into the vocational section should be made to the local board and an effort will be made to accommodate as many as possible of those who volunteer for this training.

Men in the vocational section will be rated and tested by the standard Army methods and those who are found to possess the requisite qualifications may be assigned to further training in the collegiate section.

7. In view of the comparatively short time during which most of the student-soldiers will remain in college and the exacting military duties awaiting them, academic instruction must necessarily be modified along lines of direct military value. The War Department will prescribe or suggest such modifications. The schedule of purely military instruction will not preclude effective academic work. It will vary to some extent in accordance with the type of academic instruction, *e. g.*, will be less in a medical school than in a college of liberal arts.

8. The primary purpose of the Students' Army Training Corps is to utilize the executive and teaching personnel and the physical equipment of the colleges to assist in the training of our new armies. This imposes great responsibilities on the colleges and at the same time creates an exceptional opportunity for service. The colleges are asked to devote the whole energy and educational power of the institution to the phases and lines of training de-

sired by the government. The problem is a new one and calls for inventiveness and adaptability as well as that spirit of cooperation which the colleges have already so abundantly shown.

THE EPIDEMIC OF SPANISH INFLUENZA

IN an effort to prevent an epidemic of Spanish influenza throughout the United States, Surgeon-General Blue of the Public Health Service has provided a list of methods for the control of the disease. From a telegraphic survey made by General Blue it was discovered that the disease had broken out in six United States seaport towns, Fort Morgan, near Mobile, Ala.; Newport News, Philadelphia, New York, Boston, New London and New Orleans.

Dr. Blue's bulletin of information on the disease issued primarily for physicians, contains information as follows:

Infectious Agent—The bacillus influenza of Pfeiffer.

Sources of Infection—The secretions from the nose, throat and respiratory passages of cases or of carriers.

Incubation Period—One to four days; generally two.

Mode of Transmission—By direct contact or indirect contact through the use of handkerchiefs, common towels, cups, mess gear or other objects contaminated with fresh secretions. Droplet infection plays an important part.

Period of Communicability—As long as the person harbors the causative organism in the respiratory tract.

Methods of Control—The infected individual and his environment.

Recognition of the Disease—By clinical manifestations and bacteriological findings.

Isolation—Bed isolation of infected individuals during the course of the disease. Screens between beds are to be recommended.

Immunization—Vaccines are used with only partial success.

Quarantine—None; impracticable.

Concurrent Disinfection—The discharges from the mouth, throat, nose and other respiratory passages.

Terminal Disinfection—Thorough cleansing, airing and sunning. The causative organism is short-lived outside the host.

General Measures—The attendant of the case should wear a gauze mask. During epidemics persons should avoid crowded assemblages, street cars and the like. Education as regards the danger of promiscuous coughing and spitting. Patients, because of the tendency to the development of broncho-pneumonia, should be treated in well-ventilated, warm rooms.

SAN FRANCISCO JOINT COUNCIL OF NATIONAL ENGINEERING SOCIETIES

FIVE national engineering societies which have San Francisco sections on September 4 organized what is to be known as the Joint Council of the Engineering Societies of San Francisco. The societies represented are the American Society of Civil Engineers, the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers and the American Chemical Society. Four representatives from each of these societies, making twenty men in all, form the joint council, which in turn is officered by an executive committee of five. The members of this executive committee are: C. D. Marx, chairman; E. C. Jones and E. C. Hutchinson, vice-chairman; N. A. Bowers, secretary-treasurer, and E. O. Shreve, assistant secretary.

We learn from the *Electrical World* that this organization is the outcome of several meetings of the secretaries of the five societies involved at which plans for more effective inter-society cooperation have been worked out. Some of the expected advantages are a closer touch among members of the several associations, putting the several employment bureaus together in one central office, joint meetings to discuss subjects of common interest, cooperation for the sake of economy as in mailing notices, consolidating headquarters at the Engineers' Club, etc.

In a paper on this subject read at a recent joint meeting it was pointed out that membership in a national engineering society has always carried with it a certain amount of prestige. Here in the Far West we have been content with little besides that as a return for our annual dues. In recent years local sections have taken on new importance, and it is not now uncommon to find the man who believes he can get more real benefit from his

local section than from the national organization.

Our parent societies have joined in forming the United Engineering Society, and the plan has proved eminently successful from every angle. May we not begin now to lay the foundation for branches of that organization in western centers? Why not the San Francisco branch of the United Engineering Society? At least we may suggest this as an ultimate possibility, another incentive among the opportunities that await our pioneer joint council.

The joint council will have regular meetings once a month, the executive committee convening at the pleasure of its members. The constitution tentatively adopted at the September 4 meeting sets forth the following as the purposes of the organization:

1. To foster closer relationship among the engineering societies of San Francisco, especially in those matters (*a*) where cooperation will make for more efficient "win the war" service, (*b*) where cooperation will make for more efficient service to the state of California, its cities and counties, and (*c*) where cooperation will expedite progress toward those ideals common to our several organizations.

2. To plan and carry out arrangements for joint meetings of the several societies whenever such meetings are deemed advisable and to endeavor to make joint meetings effective in developing closer relationships among members of the several societies.

3. To act generally as the clearing house for matters which involve the several societies, especially where the common good will be enhanced by working through an executive head representative of the several organizations.

The first act of the joint council was the decision to urge upon the governor of the state the appointment of an engineer as member of the state railroad commission. In making this recommendation it was pointed out that "the best interest of the state would be served by the appointment of engineers as members of commissions dealing with problems the solution of which requires technical training and experience" and that the appointment of an engineer to fill one of the vacancies on the state railroad commission would doubtless "be regarded by the people of the state as indicating a wish to place the public service on the highest plane of efficiency and will be creditable both to the appointing power and to the engineering profession."

CHEMISTS AND THE CHEMICAL WARFARE SERVICE

Major General William L. Sibert, director of the Chemical Warfare Service, addressed, on September 1, the following letter to the chemists of the United States:

This is a chemical war: therefore the War Department must have immediately available all possible information regarding chemical materials and chemical man power. Of these two essential elements chemical man power has so far received less attention. The census of American chemists made by the American Chemical Society in 1917 has been of great assistance to the War Department. Without it the present state of progress of the United States in chemical warfare would have been impossible of attainment.

However, during the same period conditions have undergone rapid and radical changes. The old census, excellent as it was, is no longer completely adequate. With the organization of the Chemical Warfare Service as an independent branch of the War Department, unifying all the elements of chemical warfare, it is obvious that the War Department must have its own set of records on a matter so vital to its own success. Moreover, these records must contain information which a short time ago was apparently of little importance. The new census must be made primarily from the viewpoint of the military status of chemists.

The importance of a prompt return of the census blank, properly filled out, by every chemist of the country, can not be overstated. American chemists are presented at this moment with one of the greatest opportunities to serve their country by the simple process of answering this questionnaire with all possible speed.

It is stated in the *Journal of Industrial and Engineering Chemistry* that as a result of the letter from the Adjutant General of the Army, dated May 28, 1918, 1,749 chemists have been reported on. Of these the report of action to August 1, 1918, shows that 281 were ordered to remain with their military organization

because they were already performing chemical duties, 34 were requested to remain with their military organizations because they were more useful in the military work which they were doing, 12 were furloughed back to industry, 165 were not chemists in the true sense of the word and were, therefore, ordered back to the line, and 1,294 have been placed in actual chemical work. There were being held for further investigation of their qualifications on August 1, 1918, 432 men. The remaining 23 men were unavailable for transfer, because they had already received their overseas orders. Each case has been considered individually, the man's qualifications and experience have been studied with care, the needs of the government plants and bureaus have been considered with equal care, and each man has been assigned to the position for which his training and qualifications seem to fit him best.

SCIENTIFIC ORGANIZATIONS OF THE ALLIED NATIONS

At the invitation of the Royal Society, a conference between representatives of the Allied nations will be held in London on October 9 to discuss the future conduct of scientific organizations. According to *Nature* it is expected that representatives from the academies of Paris, Rome, Tokyo and Washington, as well as nominees of the governments of Belgium, Portugal and Serbia, will attend. A memorandum proposed by a committee of the Royal Society points out that international scientific organizations and conventions may be divided into four groups, according to their objects and methods of procedure. A first group consists of those important agreements which fix the standards of measurements, and are essential not only in purely scientific investigations, but also in the development of many industries. A second group contains associations definitely formed for the investigation of scientific problems in which coordination of observation is essential. A third group, which hitherto has not been large in numbers, but presents some special features, embodies the efforts to organize undertakings that might be carried out in one locality, but is more economically dealt with by a division of work. The most prominent example of this type is the arrangement made between eighteen observatories to form a photographic chart of the heavens. The organization dealing with the "International Catalogue of Scientific Literature" may also be included in this group. In the fourth group is placed the large number of congresses called together by workers in some one department of science, and mainly intended to foster friendly personal relationships between those who pursue similar aims in different countries. There is, finally, in a group by itself, the International Association of Academies, which aims at coordinating the activities of international undertakings, and organizes work for which special permanent bodies do not exist and are not required. The council of the Royal Society will submit the following questions as subjects for discussion at the forthcoming conference: (1) Is it desirable for the Allied nations to establish organizations for scientific cooperation among themselves? (2) If this be agreed upon, what should be the particular forms of organization to be aimed at in geodesy, seismology, meteorology, etc? (3) Should particular academies be asked to submit proposals on those undertakings in which they have taken the leading part, such as: (*a*) The Académie des Sciences on the Commission Métrique and the Bureau International des Poids et Mesures; (*b*) The Royal Society on the International Catalogue of Scientific Literature? (4) What representations should be addressed to the governments with regard to those organizations which have hitherto received their support? The conference at present is intended to deal only with scientific subjects, but similar questions no doubt also arise on the literary side.

SCIENTIFIC NOTES AND NEWS

Samuel Wendell Williston, professor of paleontology in the University of Chicago, has died at the age of sixty-two years.

Maxime Bôcher, professor of mathematics in Harvard University, has died at the age of fifty-one years.

Mr. John O'Connor, Jr., one of the assistant directors of the Mellon Institute of Industrial Research of the University of Pittsburgh, has gone to Washington to assume the duties of civilian appointment in the Plan and Scope Division of the Quartermaster General's office.

Professor Miles S. Sherrill, of the department of chemistry, Massachusetts Institute of Technology, has been granted a leave of absence from the institute and has commenced work on explosives for the Ordnance Department.

Dr. Creelman, commissioner of agriculture in Ontario and president of the Ontario Agricultural College, has left for England, where he will consult with the directors of the University of Vimy Ridge, with respect to the agricultural training of soldiers.

Dr. F. Mollwo Perkin has been elected president and Mr. H. A. Carwood secretary of an association of chemists engaged in the oil and color and allied trades which has been organized in England.

The John Wimbolt prize in civil engineering at Cambridge has been awarded to Mr. E. B. Moullin, B.A., of Downing College, formerely of Newcroft School, Bournemouth, for an essay on "Some problems of gaseous explosions."

The Moxon medal of the Royal College of Physicians of London has been awarded to Dr. F. W. Mott.

Dr. A. S. Pearse, of the University of Wisconsin, has returned from a trip to Maracay, Venezuela, where he studied the fishes of Lake Valencia.

Professor C. M. Smith, of the department of physics, Purdue University, spent the summer in scientific work at the Bureau of Standards, Washington, D. C.

Dr. E. C. Shorey, in charge of the division of chemical investigation in the Bureau of Soils, U. S. Department of Agriculture, has resigned to accept a position with the National Aniline and Chemical Co., Inc., at Marcus Hook, Pa.

Odell E. Lansing, assistant botanist in the Field Columbian Museum, died by suicide on September 11, aged fifty-one years.

M. Charles Joseph Etienne Wolf the distinguished French astronomer, died on July 4, at the age of ninety years.

Mr. W. M. Crowfoot, of Beccles, Suffolk, who died on April 6 at eighty years of age, bequeathed a collection of exotic butterflies and moths to his wife for life and then to the Natural History Museum, University College, Nottingham; a collection of shells from the Paris basin, his cragshells, and other fossils to the Norwich Museum; a collection of shells from the Italian Pliocene basin and a collection of marine, land and fresh-water shells to the Ipswich Museum.

Since the establishment of the *Journal of Geography*, formerly the *Journal of School Geography*, over twenty years ago, the magazine has been under personal management and control. During the first thirteen years Professor R. E. Dodge of the Teachers College, New York, carried most of the responsibility. During the last eight years the present editor Professor Ray Hughes Whitbeck, of the University of Wisconsin, has carried the major part of that responsibility. During the past summer, the American Geographical Society of New York offered to take over the complete ownership and control of the *Journal* and the offer has been accepted. During the remaining four months of 1918, the present editorial and business management will continue.

The autumn meeting of the Institute of Metals was held in the rooms of the Chemical Society, London, on September 10 and 11. We learn from *Nature* that among the communications submitted were: The Resistance of Metals to Penetration under Impact, including a note on The Hardness of Solid Elements as a Periodic Function of their Atomic Weights, Professor C. A. Edwards; Grain Growth in Metals, Dr. Z. Jeffries; Rapid Recrystallization in Deformed Non-ferrous Metals, Mr. D. Hanson; The Influence of Impurities on the Mechanical Properties of Admiralty Gunmetal, Mr. F. Johnson, and A Peculiar

Case of Disintegration of a Copper-Aluminium Alloy, Dr. R. Seligman and Mr. P. Williams.

THE Società italiana per il Progresso delle Scienze, the head offices of which are in Rome, has issued, as we learn from *Nature*, the program of the tenth meeting, which is to be held in Pisa on October 16–19 under the presidency of Professor Ferdinando Lori and the secretaryship of Professor Vincenzo Reina. The success of the meetings at Rome in 1916 and at Milan and Turin in 1917 has convinced the council that it will be interpreting the wishes of the members in continuing even in war-time to maintain its activity in promoting the advancement of knowledge in the country. Mathematics, physics, chemistry and aeronautics do not figure in the proceedings of the sections, which are to be devoted mainly to geological and mineralogical papers in Class A, biological and medical in Class B, and economical in Class C. It is the object of the meeting to pay a large amount of attention to the study of the mineral resources of Italy. At the same time the Italian Thalassographic Commission is organizing a subsection of Class B on fisheries, and is presenting an annual report, while similar reports are being presented by the Glaciological Committee and the National Commission for the Development of Scientific and Industrial Progress. The Italian Association for the Study of Building Materials is to meet in Pisa at the time of the congress. The opening meeting of the scientific gathering is to be held on October 16, at the university, when an inaugural address will be given by Professor Raffaello Nasini on "A proposal for an inventory of Italy's mineral wealth." In addition to the sectional meetings, nine general lectures have been arranged for the mornings of the subsequent days, while the sections will meet in the afternoons, and an excursion will take place on the Sunday.

The British Medical Journal states that the council of the Paris Medical Faculty has drawn up a report setting forth a number of reforms and extensions which it is proposed to make in the scope and methods of its teaching work. For the teaching of pathology cinematographic apparatus will be installed in the lecture theaters and collections of films are to be made. One of the two chairs of internal pathology is to be transformed into a clinic of infectious diseases. The practical curriculum is to be completed and supplemented by a large scheme of free clinical teaching in which all the members of hospital staffs who wish to do so will take part. With the object of ensuring almost full autonomy to the services of the faculty by securing the most favorable organization for the treatment of patients and the instruction of students a commission of studies has been set up which includes representatives of the Ministries of Public Instruction and of the Interior, the Prefecture of the Seine, the Municipal Council, the University, the Faculty and the medical staffs of the hospitals. Arrangements will be made for the purpose of attracting to Paris men of science, doctors and students from foreign countries. The government has favorably received a request that it should provide funds for the improvement of existing services and for the creation of others, particularly an institute of medical biology. Internal improvements have been made in the library and museums of the faculty. A special committee has been engaged in elaborating the statutes of a society of friends of the Paris Medical faculty.

THE *Journal of Industrial and Engineering Chemistry* states that the straits to which Germany has been reduced by the cutting off of oil supplies from outside has led to some remarkable discoveries or at least communications of discoveries. Professor R. France, of Munich, claims to have discovered a new source of oil in certain cryptogamic plants growing in Bavaria to which he has given the name "Esaphone." He calculates that by adding thereto certain other parasitic plants growing in Germany some 1,200,000 kilos of oil of excellent quality can be obtained per annum. As it does not congeal except at about 40° below zero, he suggests that it would be highly useful for aeroplanes and the engines of vessels going to arctic regions. Professor France

also states that by collecting the drops of resin which collect in spring upon felled pine and fir trees about 60 liters of oil could be secured from every cord of wood.

The Technical Department, Aircraft Production, of the Ministry of Munitions of Great Britain has prepared a detailed report on an example of the new German 300-h.p. Maybeck aero engine taken from a Rumpler biplane which was brought down in France in January last. These engines are described in the report as undoubtedly representing a great improvement in general design and efficiency as compared with the old 240-h.p. Maybach engines found in Zeppelin airships. The quality of the workmanship of every part, including the exterior finish throughout, is exceptionally good, and the working clearances are carried to very fine limits. Every part, nevertheless, shows the usual German characteristics of strength and reliability, combined with standardization and ease of manufacturing in preference to the saving of weight. The engine has six vertical cylinders with a bore of 6.5 in. and a stroke of 7.09 in., and weighs 911 pound complete with propeller boss and exhaust manifold, but without fuel or oil. On an hour's test, running at the normal speed of 1,400 rvolutions a minute, it gave on the average 290 b.h.p., the weight being thus a little over 3 pounds per h.p. The consumption of petrol was 0.55 pint and of lubricating oil 0.038 pint per b.h.p. hour. The C.4 type of Rumpler machine from which this engine was taken is a two-seater biplane designed for long-range artillery reconnaissance and photography. These machines are said to be generally flown at high altitudes—15,000 feet to 17,000 feet—until over the lines, and from French reports the 300 h.p. Maybach engines are more flexible and regular in running than the 260-h.p. Mercédès engines generally fitted in them. Their armament consists of one Spandau gun fixed in front of the pilot's seat and firing through the propeller, and one swivelling gun mounted in the observer's seat behind.

UNIVERSITY AND EDUCATIONAL NEWS

At a meeting of the General Municipal Council and the Chamber of Commerce at Bordeaux on September 10, the proposal to establish in honor of the President of the United States a Franco-American university of applied sciences, commerce and industry was unanimously adopted.

The Birmingham Metallurgical Society has planned to award scholarships at Birmingham University to technical school students in metallurgy. The purpose is to assist boys who otherwise would be unable to afford a university training in metallurgy.

Dr. H. C. McNeil, associate chemist in the Bureau of Standards, has been appointed acting professor of chemistry in George Washington University, Washington, D. C., succeeding Dr. Charles E. Munroe, who assumes the chairmanship of the committee of explosives investigations under the National Research Council.

William C. Morse, of Washington University, St. Louis, has been elected professor of geology at the Mississippi Agricultural and Mechanical College.

Professor Owen W. Mills, formerly of Westminster College, has been appointed professor of biology at Middlebury College.

DISCUSSION AND CORRESPONDENCE

DUAL QUEENS IN A COLONY OF HONEY BEES

During a recent visit, June 3–6, 1918, to the Massachusetts Agricultural College at Amherst, Mass., by the courtesy of Dr. B. N. Gates I was given the unusual opportunity of accompanying him on his inspection of the forty colonies of the bee yard.[1]

It has so frequently been stated that two queens are rarely found in one colony of honey bees that the occurrence of two queens, evidently mother and daughter, living side by side

[1] In addition to many interesting facts of honey bee behavior, I was able to collect material for a morphological study of the developmental stages of the three castes of honey bees. I am deeply grateful to Dr. Gates for his assistance and kindness in securing my material.

in an apparently peaceful condition, seems worthy of note.

The colony in which the dual queens were found is colony 95 of the Massachusetts Agricultural College Bee Yard, and the data in regard to its history were given me by Dr. Gates, with whose permission these notes are published.

On May 23, 1918, Dr. Gates had inspected this hive and found only the old queen. No queen cells were present and the colony was of medium strength, occupying only one story of the hive. The queen was introduced to this colony on August 1, 1917, and was therefore not old, and came of strong stock which had been selected for four years to resist the European foulbrood.

Thirteen days later, on June 5, 1918, on opening the hive a large number of queen cells was first noted; there were seven in all, three cells containing eggs, one a larva about four days old, two with young pupæ, and one empty cell with its cap thrown back, showing that a queen had recently emerged. The varied ages of the developing queens in these cells was interpreted by Dr. Gates as indicative of a tendency towards "supersedure," that is, the replacement of the old queen by a new one.

After a short search, a young virgin queen was found on the comb, her appearance showing that she had only emerged a few hours before. On another comb the old queen was found laying. Her wings were slightly frayed, although she was less than a year old, and her abdomen was considerably larger than that of the virgin queen.

In normal cases of "supersedure" the parent queen is destroyed by the workers prior to the emergence of the virgin, and in swarming it is known that the parent queen leaves the hive on the day that the cell of the new queen is capped.

Such a case of "supersedure," with the survival of both parent and daughter queens in the same colony, suggests a return of the probable ancestral condition of multiple queens, the condition that prevails to-day among bumble bees in the late summer, among certain wasps, and in ants.

After the discovery of the dual queens in a single colony, the old queen with most of the brood was confined in the second story of the hive, with a "queen excluder" above the first story, in which the virgin queen was placed with one sheet of brood and nine empty combs. The subsequent history of the old or parent queen may explain why her workers attempted to supersede her.

CAROLINE B. THOMPSON
WELLESLEY COLLEGE

PARAMECIA WITH EXTRA CONTRACTILE VACUOLES

THREE years ago I found a race of *Paramecium caudatum* which possessed more than two contractile vacuoles. A preliminary note on the behavior of these vacuoles was published in this journal (1915, Vol. 42) and two years later an account of the morphology, physiology and genetics of this new race appeared in the *Journal of Experimental Zoology* (1917, Vol. 23). In this paper the following conclusions were presented:

1. The number of contractile vacuoles range from two to seven. Three- and four-vacuoled forms are most abundant.

2. Apparently any individual has the potentiality for higher numbers of vacuoles. The appearance of the vacuoles depends on two things —(*a*) the rapidity of division; rapid fission does not give time for the vacuoles to form, (*b*) the amount of catabolic waste in the environment. If the percentage of waste is relatively high the average number of contractile vacuoles in the paramecia of the culture is high. In new cultures made up with fresh hay infusion the average number of vacuoles is low. The effect of rapidity of division can be partially overcome, since old cultures in which the rate of fission has been increased through the addition of new food show an average vacuole number much higher than found in fresh infusions.

3. Although several generations may pass without the appearance of extra vacuoles the potentiality for these organs is inherited and merely waits for the proper (apparently environmental) conditions to call them forth.

4. The extra vacuoles are, in almost all

cases, located in the posterior half of the animals. In a few individuals one extra vacuole was found in the anterior end.

5. It was tentatively suggested that this new character might have been the result of heat, as the animals in the original culture had been used in temperature experiments.

The last statement now seems doubtful, for since the appearance of these papers I have heard from other investigators of similar paramecia being observed in widely separated parts of the country. They have been reported in Wisconsin, Indiana, Massachusetts and Connecticut. Those discovered in Indiana possessed either three or four vacuoles.

This note was prepared in hope that attention might be attracted to the vacuole numbers so that more data on this variation may be obtained. The possession of extra contractile vacuoles makes this race of paramecia exceedingly important, not only because it is a variation of the common type but because the sensitive response of the vacuole number to changes in the environment may make these individuals useful as indicators in certain classes of experiments.

ROBERT T. HANCE
ZOOLOGICAL LABORATORY,
UNIVERSITY OF PENNSYLVANIA

MATHEMATICAL INSTRUCTION AND THE WAR

IN view of the evident desirability of establishing a central agency for the gathering and dissemination of information pertaining to mathematical instruction in relation to the war, the *American Mathematical Monthly* is opening a new department, entitled "Collegiate Mathematics for War Service." Any reader of SCIENCE in possession of suitable information is urged to send it in at once. If the information is of sufficient importance, and in the opinion of the editorial staff of the *Monthly*, delay in publication might greatly diminish its value, preprints will be made for the earliest possible distribution. Already preprints of several articles dealing, in the main, with mathematical training for naval service, are in the course of preparation. The chief consideration relative to the new department is maximum possible service in our war program; other considerations, such as ideals of accuracy, completeness and scholarship must be regarded as secondary. Suggestions for making the new department as useful as possible will be welcome from all quarters.

HENRY BLUMBERG
810 W. OREGON ST.,
URBANA, ILL.

QUOTATIONS

SCIENCE AND THE CIVIL SERVICE

THE great technical developments of the nineteenth century, which were due in a large measure to the influence and progress of science, have undoubtedly introduced not only a great transformation in the internal affairs of the country, but also an altered outlook in the external relations of the state. In consequence, many and extensive have been the changes gradually brought about, during the past century, in the duties and responsibilities of the civil service. Every government department has been affected to some extent; in some of them there have come into existence innovations which are of a very far-reaching character. The outstanding feature of this evolution is that the work of government departments has to-day entirely ceased to be of a purely administrative order, whether it be in relation to legislative measures referred thereto for preparation, revision, or criticism, or to the operations conducted therein, or to the sphere of human activity superintended, controlled, or managed thereby. The business of every government department is to-day to some extent technical or scientific; in the case of some departments the administrative aspect predominates; in others it is the technical or scientific aspect that plays the more important rôle.

What, then, has the state done to ensure that the personnel of the civil service, through whom its responsibilities must be largely exercised, shall be properly qualified and equipped for dealing, under present-day conditions, with the social, industrial and commercial problems which must come before it for legislative, executive, or other action?

One important step has been taken in relation to this matter: it has been definitely laid down that candidates for the civil service shall, before appointment, be required to undergo some test as to their knowledge and capacity. To give effect to this decision the Civil Service Commission was, by an order in council dated May 21, 1855, appointed to organize a system of examination; the Commission continues to be charged to the present day with the duty of providing suitable candidates for the public services. In 1870 the principle of open competition was introduced for the purpose of filling certain specified situations in the civil service, without, however, entirely abolishing "patronage" appointments. Afterwards, in 1876, the clerical establishment of the civil service was divided into a higher and a lower division; in 1890 the name "lower division" was altered to "second division," and a provision introduced making it possible for a "second division" clerk to be promoted to a higher division clerkship. It is the clerical establishments of the civil service which have alone received attention in the foregoing legislation.

Obviously, it is on the complete success of the competitive examination scheme in force that the welfare of the civil service, and, therefore, the protection of the public interest, must depend. It is here that a serious failure has occurred; the open competitive scheme has not been an entire success; it has been productive of a very unfortunate result. The system of marking adopted in the examination favored candidates whose education consisted largely in the learning of ancient Greece and Rome, and handicapped those whose *forte* was science.

Furthermore, in practically every case the officials who have in recent years received "patronage" appointments in the higher division of the civil service are men whose education and training have been identical in character with those of civil servants entering the service by open competition. In consequence, at the present day the highest administrative posts in nearly every department are monopolized by men whose learning is entirely literary. Further, the technical officers—that is, those in whose education science has played the preponderating rôle, and on whose skill and knowledge the welfare of many of the public services very largely depends—are almost entirely excluded from a share in the important administrative posts; needless to say, much to the injury of the public services.

Could it be shown that a purely classical or literary education really tends to develop or to produce administrative talent in an individual superior to that which can be obtained by means of a scientific education and technical training, as is sometimes claimed, there might indeed be some excuse for the retention of the principle of selection adopted; but there is none in actual fact. There exists, on the contrary, abundant evidence to prove conclusively that administrative talent is no exclusive privilege or quality of those who have received a purely classical or literary education: the names are familiar, in wide circles, to high and low, of men who have proved themselves capable administrators of the highest order; men, possessing the capacity of a Cromer or of a Kitchener, in whose education instruction in science also occupied a very prominent place; men whose early years were, too, spent in technical spheres.

The opinion has been gaining ground for some time past that the administrative system of government departments is unsatisfactory. The extracts from the reports of the Exchequer and Audit Department published from time to time, wherein publicity is given to the defects in the administrative arrangements in connection with the public services, have provided, in relation to such matters, authentic evidence tending to confirm, in the public mind, the unfavorable opinions that prevail so widely as to the unbusinesslike methods of the civil service and the general lack of capacity shown by a large majority of its members. Other authentic evidence is available—some recorded, some not; some public property, some not—which provides an indication that scientific knowledge and technical experience are held in disrepute in many, happily not in all, government

departments; and, further, that the professional opinions of technical officers too frequently are not given the due weight which they deserve. Science has done much for the civil service; it has not, in return, received the recognition which it merits.—*Nature*.

SCIENTIFIC BOOKS

The Physical Chemistry of the Proteins. By T. BRAILSFORD ROBERTSON. New York, Longmans, Green and Co. Pp. 483. $5.00.

The limiting adjective "physical" might be omitted from the title of Robertson's new edition, so completely does it cover the field of protein chemistry. Part I., including the first third of the book, is devoted to the chemical constitution of the proteins, their preparation, methods of estimation, and the various types of compounds which they form with each other and with acids, bases, salts, heavy metals, etc. Part II. is devoted to the electro-chemistry of the proteins; Part III. to their physical properties, such as gelatinization, swelling, coagulation, viscosity and surface tension, not included under Part II.; and Part IV. to the hydrolytic and synthetic actions of enzymes on proteins. Throughout the work statements and discussions are placed on a quantitative basis by the use of mathematical treatment wherever data sufficiently complete and accurate to justify it are available. Biological applications are kept continually in view. Despite the fact that he covers so wide a field and thoroughly reviews the literature, the author seldom fails to augment the interest of his material by presenting it from a view-point developed from his own experimental and intellectual researches.

DONALD D. VAN SLYKE

SPECIAL ARTICLES

UNLIKE REACTION OF DIFFERENT INDIVIDUALS TO FRAGRANCE IN VERBENA FLOWERS

IN classifying the floral colors in a certain pedigree of verbenas, the writer noticed a considerable difference in the amount of fragrance evident in their flowers. Some plants appeared to have flowers devoid of odor while the flowers of others were strongly fragrant. One with pale pink flowers, which may be called plant *A*, was especially pleasing in this respect. In showing it to my assistant, Mr. B. T. Avery, Jr., I remarked that it should be called an arbutus verbena since the flowers resembled the arbutus in both color and odor. To my surprise he failed to find any fragrance at all in the flowers of this plant. Moreover, when he arranged the pedigree according to the strength of fragrance which they gave to him it was roughly in the reverse order from that in which I should have arranged them. The most fragrant of all to him was a red-flowered plant the flowers of which to me were absolutely without fragrance. This for convenience we may call plant *B*. The flowers of plant *B* then were fragrant to him but not to me while those of plant *A* were fragrant to me but not to him. Each of us agreed that the other's favorite had a very slight odor that could be best described as a leafy or plant odor which apparently was the same as that of the foliage. Moreover, he described the fragrance from plant *B* as of a spicy nature resembling that from a carnation flower to which I am not insensible, while the fragrance of plant *A* seemed to me to closely resemble that of arbutus, with which he is also familiar. It did not seem to be the case that we both perceived the same odors but, having different preferences, dignified the one which we liked with the term fragrant. Rather the facts indicated that he was insensible to the odors in the flowers of *A* while I was insensible to odors in those of *B*. We repeated the tests many times under various conditions with the same results. He never was able to perceive any fragrance from *A* while, except upon a few occasions when I detected a slight odor such as he had described, I was unable to find any fragrance in his favorite.

In addition to ourselves, others in the community were tested for their reaction to fragrance in our plants *A* and *B*. The later tests were made in October. Due perhaps to the lateness of the season or to other conditions, the few remaining flower clusters then produced by plant *A* were not always fragrant.

In making the tests, an *A* flower cluster that was fragrant to me was used in contrast with a *B* flower cluster that was adjudged fragrant by Mr. Avery or by one who had been found to react to it in the same manner in which he did. The person to be tested was asked to decide which of the two was the more fragrant. There was an amusing uniformity in the manner of response. The subject would generally say he feared he was not smelling well that day, would then blow his nose and almost at once pick out either *A* or *B* and wonder how any one could think the other fragrant. When questioned as to fragrance in the flowers that were not preferred, he would generally say they were not fragrant but had a slight odor variously described as being a plant odor or an odor like a dead leaf.

The pleasure obtained from odors is often closely bound up with other associated perceptions. For this reason, in some cases the individuals tested were asked to smell the flowers with their eyes closed. Color associations were shown to have no controlling influence in the reaction. In some instances the tests were repeated but without affecting the results.

Of the men, 17 preferred the flowers of *A* while 9 preferred those of *B*—a ratio of 2 to 1. Of the women, 9 preferred *A* while 4 preferred *B*. In general the results were clear-cut and the individuals tested found fragrance in one of the two flowers and not in the other. A few, however, found a slight fragrance in the flowers that they did not prefer and two women found fragrance in both and could not decide between them.

Flowers from the two plants were exhibited at a staff meeting of the Carnegie Station and were repeatedly smelled by the seven members present. Five found fragrance in A and not in *B* and two showed a reversed reaction.

It is a trite proverb that in matters of taste there can be no argument. The assumption is that though we differ in our preferences, our perceptions are essentially the same. In the case of the verbena flowers under discussion, however, it has been shown that preferences of different individuals in regard to fragrance are based upon radical differences in their perception of odors. The condition suggests color-blindness, but those who are color-blind react to both of two colors when they are unable to distinguish between them. About two thirds of the individuals tested with the verbena flowers were "blind" to odors in the flowers of plant *B* while perceiving odors in *A*. On the other hand, about one third were "blind" to odors in *A* while perceiving odors in *B*. It is as if my black looked white and my white, black to Mr. Avery and his group; while from his viewpoint, I and the group that agreed with me were equally distorted in our vision.

It is well known that people differ considerably in their ability to hear tones of higher musical pitch. Many can not hear the notes of the cricket. Other insects produce sound vibrations of so high a pitch that they are inaudible to any human ear, though perceived by related insects. The peculiarity in the perception of the verbena fragrance might resemble the individual peculiarities in the powers of hearing if it were true that a large group of people could hear the extremely high musical notes and not the lowest tones while another group could hear the lowest and not the highest.

The acts brought out in the foregoing discussion furnish an added example of the difficulty in classifying characters studied in inheritance. A group of different individuals in investigating fragrance in our pedigree of verbenas would be classifying their own olfactory perceptions as well as the actual odors in the flowers. It is well for us to recognize the limitations of the personal equation. Discrepancies in conclusions reached by different investigators may not be due to any fault in logical reasoning or to lack of intellectual honesty. Their diverse conclusions may be inevitable, given only differences in their sensory reactions and in their mental experience.

A. F. Blakeslee

Carnegie Station for Experimental Evolution

THE WHITE-SPOT DISEASE OF ALFALFA

For a number of years the writer has observed the white-spot disease of alfalfa, par-

ticularly in the middle-western, intermountain and Pacific Coast states. Usually this disease is not considered serious by alfalfa growers, but in many instances the writer has noted that the disease may be more or less disastrous and may produce a very decided loss in yield. During the last few years particular attention has been paid to this disease because of its very great prevalence in the intermountain states. In the Salt Lake Valley, Utah, this disease has been considered by many of the farmers as being due entirely to the smoke from the smelters. However, the writer has found it to be quite as serious in districts far removed from the Salt Lake Valley where soil and climatic conditions are the same. Because of the importance of the disease the writer has made some studies of which a preliminary report is given below.

Reference to the literature indicates that very little has been done to determine the real cause of the disease. The earliest reference to the disease is that by Stewart, French and Wilson.[1] These authors indicate that they believe this disease to be due to a physiological disorder of some kind. The next references are by Reed & Crabill[2] and by Clinton.[3] The most recent reference is by Crabill,[4] who believes that white spot is due to the wounding of the tissue of the crowns of the plants. His experiments indicate that by cutting away a portion of the tissues the typical white spot was produced. The occurrence in nature, he believes, is due to the fact that the injury to the plants is produced in the late fall or winter because of the fact that he has only observed the disease in the early spring. The wounding of the plants in cultivation, he believes permits the entrance of certain fungi which tend to rot the crowns and later the roots. Such plants, he has found, will show white spot in the early spring, shortly after the plants have started to grow. Recently, however, Crabill indicates (letter of April 17, 1918) that he did not always find a crown rot of the affected plants and he thinks that crown rot may, therefore, be only a circumstance and, after all, not the true cause.

[1] "Troubles of Alfalfa in New York," by F. C. Stewart, G. T. French and J. K. Wilson, Bulletin No. 305, November, 1908, New York Agricultural Experiment Station, Geneva, N. Y.

[2] Va. Station Technical Bulletin, 2, 39, 1915.

[3] Conn. Sta. Report, Report of the Station Botanist, 1915, 425.

[4] *Phytopathology*, Vol. 6, No. 1, 1916, pp. 91.

In carrying out some experiments on the treatment of soils with various water-soluble substances, the writer, to his surprise, found that white spot suddenly appeared in a large number of the treated plots. Each plot covers an area of 25 square feet, composed of fifty plants from two to three years old. The plants have been very carefully cultivated with a hoe and the crowns have never been injured in any way. In general the white spot appeared within sixty to seventy hours after the soil had been treated. In no case did a single specimen of white spot appear in the check plots. Furthermore, white spot did not appear in any of the plots where the total water-soluble substance applied was below a certain amount. Further experiments indicated that the "soil solution" alone would not produce white spot, but that the factors of soil temperature, atmospheric temperature, relative humidity of the atmosphere and light are important. In other words, it requires a certain coincidence of these various factors at what we shall term the optimum before an effect was produced upon the plants such as would cause white spot to appear.

It may be stated here that the experimental plants are growing in a sandy-loam soil and at no time previous to the experiment had white spot appeared.

The work has progressed to the point where the writer believes that the osmotic pressure of the soil solution is one of the important factors in the production of white spot, not only under experimental conditions but under field conditions as well. With conditions for transpiration at the optimum, lessening or preventing endosmose, by reason of a soil solution having a higher osmotic effect upon the cells of the transpiring organs. The degree of injury produced will depend upon the factors enumerated above, together with the time factor which is all important. If these factors are

coincident for a relatively short period of time only, a few white "spottings" at a distal end of the leaflets may result; if the time element is lengthened, all the cells of the leaflet may suffer a water loss much below the wilting coefficient, and instead of a "spotted" appearance the entire leaflet will bleach white. This is exactly what happens under both experimental and field conditions. In the intermountain country where a very large number of observations have been made, it has been noted that fields showing a considerable incrustation of alkali when irrigated exhibited white spot in more or less amount, depending upon the other environmental factors above mentioned. Also, a sudden rise of the water table in irrigated districts has brought about the same appearance of the plants in the fields. Some very interesting observations have been made on fields adjacent to each other, with plants of the same age and all conditions the same excepting the application of water. The irrigated fields showed extensive white-spot trouble, while the non-irrigated fields showed none.

It has been noted by eastern pathologists who have made observations on this disease that it occurs mainly in the spring of the year. However, the writer has observed it in the intermountain districts during the early spring, during mid-summer and during the late fall; in short, throughout the entire growing season.

Specimens of artificially produced white spot of alfalfa were submitted to several plant pathologists who reported that these specimens were identical with diseased alfalfa plants which they had themselves collected.

An extended report will be published in due time after the completion of certain experiments which are now in progress.

P. J. O'Gara
American Smelting and Refining Co.,
Salt Lake City

THE POLYHEDRAL VIRUS OF INSECTS WITH A THEORETICAL CONSIDERATION OF FILTERABLE VIRUSES GENERALLY

In a previous paper[1] J. W. Chapman and I called attention to the fact that the wilt or polyhedral disease affects many different species of insects. We also showed that the disease is not produced by bacteria, but is caused by minute organisms capable of passing through diatomaceous filters, and further attempted to demonstrate that the polyhedral bodies always found associated with the disease are not organisms, as supposed by Bolle, Fischer, Marzocchi and Knoche, but reaction bodies—simply nucleoprotein by-products.

In order to satisfy myself that we were really dealing with an organism and not merely with an enzyme, toxin or other material a large series of passage infections were instituted. Twenty-five gipsy moth caterpillars were infected at a dilution of 1:1,000 with material obtained from a caterpillar previously dead of wilt. The animal was merely ground up, sterile water added and the whole filtered through a sterile Berkefeld grade "N" candle. All twenty-five caterpillars fed with the filtrate died typically of wilt during the course of three weeks, whereas twenty-five controls fed with the autoclaved filtrate lived, pupated and transformed into moths. One animal dead in this first series was prepared, the material diluted as before (1:1,000), filtered and fed to another series of twenty-five caterpillars. The experimental animals all succumbed, whereas the controls did not. Third and fourth passage infections were performed and the results were similar with the exception that the period from infection to death was considerably shorter at the fourth passage than at the first three. This shortening of the time between infection and death seems to point towards an increase in virulence with successive passages.

There are certain autocatalytic substances like chromatin that increase progressively, so to the physiologists my passage infections may not necessarily be proof for the contention that I am dealing with parasitic ultra-microscopic organisms. However, if one reviews the field of the filterable viruses[2] and compares all of the results obtained by other workers with my results, one can not but feel inclined to

[1] *Biol. Bull.*, Vol. XXX., No. 5, pp. 367–390.

[2] Thirty-two diseases are now known to be caused by filterable viruses.

adopt the view that one is dealing with minute parasitic forms. Some of the filterable viruses (pleuro-pneumonia of cattle, fowl pest, fowl diphtheria, epithelioma contagiosum and Novy's rat disease) have been cultivated, so that the question as to whether we are dealing with organisms or not is solely an academic one. We are justified at present, however, in not classifying such viruses either with the plants or animals.

TABLE SUMMARIZING CHARACTERS OF POLYHEDRAL VIRUS OF INSECTS

1. Cultivation of virus	Has not been cultivated
2. Filtration of virus	Passes through Berkefeld "N" but not through Pasteur-Chamberland filter
3. Examination of virus with ultra-microscope.	Nothing visible that could be interpreted as being different from minute protein or pigment particles
4. Effect of heating on virus when suspended in water	Destroyed at 60° C. in 20 minutes
5. Effect of dry heat on virus	Destroyed at 70° C. to 80° C. in 20 minutes
6. Effect of drying on virus at room temperature.	Resistant for 2 years
7. Effect of glycerine on virus	Resists 98 per cent. for 6 months
8. Effect of direct sunlight on virus when dry	Resistant for 12 hours
9. Effect of putrefaction on virus	Resistant for an indefinite time
10. Effect of alcohol on virus	Destroyed by 80 per cent. in 15 minutes
11. Effect of carbolic acid on virus	Destroyed by 5 per cent. in 3 weeks.
12. Effect of virus on 1 per cent. sugar solutions	No growth, no fermentation
13. Effect of virus on methylene blue and sodium nitrate solutions	No growth, no reduction
14. Effect of virus on gelatin and casein	No growth, no liquefaction

The table gives a summary of the chief characters of the wilt virus. The virus used in these tests was prepared from diseased gipsy moth, army worm and tent caterpillars. That proteins like gelatin and casein are not affected when treated with the filtrate in which the virus has been concentrated by centrifuging is curious because insect tissue is completely emulsified through the action of the wilt virus. This action is therefore probably a cytolytic one due to the action of toxins and is not caused by the elaboration of a proteolytic enzyme on the part of the virus.

In a physico-chemical explanation of the origin of organisms on our planet the filterable viruses seem to be of considerable interest and I do not understand why they seem to be so persistently neglected by all writers on the evolution of life. The filterable viruses probably realize Osborn's[3] "hypothetical chemical precellular stages"; they lie somewhere in the scheme between simple colloidal and more complex cellular states like bacteria. Some thirty-two or thirty-three disease-producing filterable viruses are now known to exist, so it is reasonable to assume that the earth, water and atmosphere are full of non-parasitic forms which we have no means of recognizing at present.

R. W. Glaser

Bussey Institution,
Harvard University

[3] "The Origin and Evolution of Life," by Henry Fairfield Osborn, Charles Scribner's Sons, New York, 1917, p. 80.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

② SCIENCE

FRIDAY, SEPTEMBER 27, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

MAGNETIZATION BY ROTATION[1]

So far as we know at present, a magnetic substance, that is a substance whose molecules are elementary magnets, can be magnetized in two ways, and only two ways: In the first place it can be be magnetized by creating a magnetic field in it or putting it in a magnetic field, as has been known for very many years; and, in the second place, it can be magnetized by simply setting it into rotation in a region initially neutral magnetically, and both initially and finally neutral electrically. It is chiefly with this latter process that we are concerned at this time.

In this process, as we shall see, the magnetization is produced *directly* by a sort of molecular gyroscopic action, which distinguishes it sharply from other processes in which *magnetic fields* are produced by rotation, but in which *magnetization* may or may not result, according to circumstances. It will be conducive to clearness to consider briefly some of these processes.

Thus if we take a tube of brass, or other non-magnetic substance, electrify it, and rotate it about its axis, a magnetic field will be produced similar in a general way to the field which would be produced by winding the tube with a coil of insulated wire and passing an electric current through it, as Rowland proved over forty years ago. So far, there is no magnetization. But if a rod of iron is introduced into the tube, and either maintained at rest or rotated with it, the rod will become magnetized—not because of its rotation, but be-

[1] An address delivered before the National Academy of Sciences, April 22, 1918. Most of the material presented here is taken from papers previously published in SCIENCE, the *Physical Review* and the *Proceedings of the National Academy of Sciences.* Detailed accounts of most of the work are given in the *Physical Review,* 6, 239, 1915, and 10, 7, 1917.

cause of the magnetic field, in this case produced by the rotation of the charges. There would be a similar result, and a similar interpretation, if the rod alone were to be given the charge and rotated.

Again, if we take a metal rod and rotate it in a magnetic field, electric currents will in general be induced in it; and the magnetic field due to these currents will, if the rod is made of magnetic material, change its magnetization. Experiments of this kind were made about one hundred years ago by Barlow, Christie and Arago.

In each of these cases, and in others which might be mentioned, a *magnetic field* is produced by the rotation, and it is this field which produces the magnetization if a magnetic substance is present.

Coming now to the other or gyroscopic process of magnetization, and starting with a neutral rod of iron or other magnetic substance, we can magnetize it directly by mere rotation, and a magnetic field will result from this magnetization.

In order to understand this process it is necessary to consider first, a simple case of the behavior of a gyroscope; and second, the modern interpretation of Ampère's theory of molecular currents.

Here we have a gyroscope whose wheel, pivoted in a light frame, can be rotated rapidly about its axis A. Except for the action of two springs, this frame and the axis A are free to move in altitude about a horizontal axis B, perpendicular to A; and the axis B and the whole instrument can be rotated about a vertical axis C. If the wheel is spun about the axis A, and the instrument then rotated about the vertical C, the wheel tips up or down so as to make the direction of its rotation coincide more nearly with the direction of the impressed rotation about the vertical axis C. If it were not for the springs the wheel would tip until the axes A and C became coincident. The greater the rotary speed about the vertical the greater is the tip of the wheel. When the wheel's speed about the axis A is zero, no tip occurs.

Now according to the modern version of Ampère's hypothesis, each molecule of a magnetic substance has a magnetic moment, or is a magnet, because it consists in part at least of electrons revolving in fixed orbits with constant angular velocities about an oppositely charged nucleus, and producing a minute magnetic field somewhat like that due to a small loop of wire traversed by an electric current.

If these electrons, revolving in the same general direction, have mass, each molecule has therefore angular momentum like the wheel of a gyroscope; and if the body of which it is a part is set into rotation about any axis, the molecule must change its orientation in such a way as to make the direction of revolution of its electrons coincide more nearly with the direction of the impressed rotation.

Only a slight change of orientation can occur on account of the forces due to adjacent molecules, which perform the function of the springs in the experiment with the gyroscope. The rotation thus causes each molecule to contribute a minute angular momentum, and thus also a minute magnetic moment, parallel to the axis of rotation; and thus the body, whose molecular magnets originally pointed in all directions equally, becomes magnetized.

If the revolving electrons are all positive, the body will become magnetized in the direction in which it would be magnetized by an electric current flowing around it in the direction of the angular velocity imparted to it. If they are all negative, or if the effect of the negative electrons is preponderant, it will be magnetized in the opposite direction. This is what actually happens.

For a simple type of molecular magnet a somewhat exact theory of the effect can be developed.

Assume the molecule (Fig. 1) to consist of n (one or more) similar electrons, all positive or all negative, with total charge ne and total mass nm, revolving in a circular orbit of radius r with constant angular velocity ω (and areal velocity $a = \frac{1}{2}\omega r^2$) about a much more massive, and fixed, nucleus with charge $-ne$.

This molecule will have a magnetic moment $\mu = nea$, a moment of inertia about the axis of revolution $C = nmr^2$, and an angular momen-

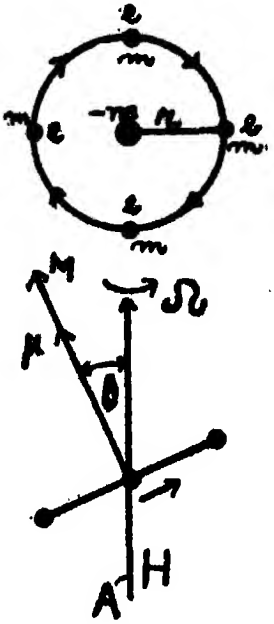


FIG. 1.

tum $M = C\omega = nmr^2\omega = 2nma$ about this same axis. The ratio of the angular momentum to the magnetic moment is

$$\frac{C\omega}{\mu} = 2\frac{m}{e}$$

The vectors representing the angular momentum and the magnetic moment are thus in the same or opposite directions according as e is positive or negative.

If now the body of which this molecule is a part is set into rotation with angular velocity Ω about an axis A, the molecule, or the orbital ring, behaving like the wheel of a gyroscope, will strive, as it were, to take up a position with its axis of revolution coincident with that of the impressed rotation; but it will be prevented from turning so far by a torque T due to the action of the rest of the body and brought into existence by the displacement. In a minute time kinetic equilibrium will be reached, and the axis of the orbit will then continuously trace out a cone making a constant angle θ with a line through its center parallel to the axis of the impressed rotation. When this state has been reached, as is known from dynamics, and as can easily be established by applying the second law of motion,[2] by Lagrange's equations, or otherwise,

$$T = \sin\theta \cdot C\omega \cdot \Omega\left(1 + \frac{1}{2}\frac{\Omega}{\omega}\cos\theta\right)$$

Now imagine the body, instead of being rotated, to be placed in a uniform magnetic field whose intensity H is directed along the previous axis of rotation, and consider a molecule whose magnetic axis, after displacement by the field, makes the angle θ with H. The

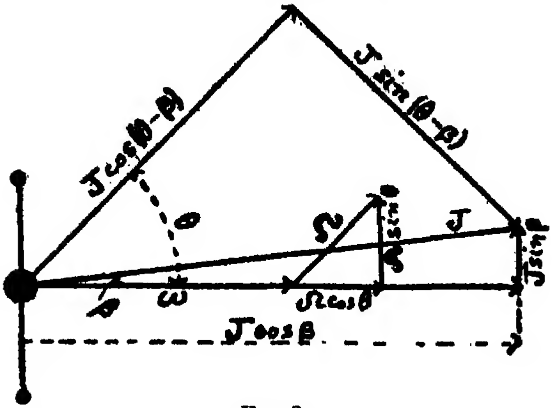


FIG. 2.

molecule would keep on turning under the action of the field until its axis coincided with H, but is prevented from doing so by the torque T' upon it due to the action of the rest of the body and brought into existence by the displacement. This torque is well known to be

$$T' = \mu H \sin\theta$$

[2] The expression for T can be found readily from Fig. 2. Let A denote the moment of inertia of the ring about a diameter, and β the angle between the vector representing J, the total angular momentum of the ring, and the vector representing ω. J can be resolved into two rectangular components, one parallel to the axis of the impressed rotation, viz., $J\cos(\theta - \beta)$, which is constant, and one perpendicular to this axis, viz., $J \sin(\theta - \beta)$, which has the constant rate of change $\Omega J \sin(\theta - \beta)$. By the second law of motion this is equal to the torque T. Expanding this expression for T, substituting for $J\cos\beta$ and $J\sin\beta$, the components of J parallel and perpendicular to the axis of the ring, their equals $C(\omega + \Omega\cos\theta)$ and $A\Omega\sin\theta$, and noting that $A = \frac{1}{2}C$, we obtain the relation sought.

To find, therefore, the magnetic intensity which would produce the same effect on the orientation of the molecule as would be produced by rotating the body at the angular velocity Ω, all we have to do is to equate T and T'. This gives

$$\mu H \sin\theta = \sin\theta \cdot C\omega\Omega\left(1+\frac{1}{2}\frac{\Omega}{\omega}\cos\theta\right)$$

or

$$H = \frac{C\omega}{\mu}\cdot\Omega\left(1+\frac{1}{2}\frac{\Omega}{\omega}\cos\theta\right) = 2\frac{m}{e}\Omega\left(1+\frac{1}{2}\frac{\Omega}{\omega}\cos\theta\right)$$

The values of Ω experimentally attainable are so small in comparison with any possible values of ω that the last term is negligible. Hence we have for any molecule in the body, whatever its orientation and whether it contains one or more orbits,

$$H = 2\frac{m}{e}\Omega$$

or

$$H = 4\pi\frac{m}{e}N$$

if N denotes the angular velocity in revolutions per second.

If therefore only one kind of electricity, with fixed ratio of mass to charge, is in orbital revolution in the molecules of a magnetic body, rotating it with the angular velocity N revolutions per second is equivalent to putting it in a magnetic field of strength H, the intrinsic magnetic intensity of rotation, such that, with great precision,

$$H/N = 4\pi\frac{m}{e}$$

If we assume that negative electrons alone are in orbital revolution, the value of the second member of this equation, according to well known experiments on electrons in slow motion, is -7.1×10^{-7} electromagnetic units, and H/N should be equal to this quantity and identical for all magnetic substances. If positive electrons also participate the magnitude of H/N should be smaller.

If the Ampèreian currents consist in the motion of actual matter, so that the molecules of magnetic substances have angular momentum, an ordinary magnet or electromagnet itself should behave to some extent like a gyroscope when set into rotation. The first to see this, as well as the first to see any relation between magnetism and angular momentum, appears to have been Maxwell, who constructed apparatus for experiments on the subject as early as 1861.

In Maxwell's apparatus an electromagnet was pivoted in a circular frame in such a way as to be free to rotate about a horizontal line through its center of mass and perpendicular to its magnetic axis. With the magnetic axis making an angle θ with the vertical, the frame was rotated at high speed about a vertical axis, also passing through the magnet's center of mass, and observations were made for a change in θ, stability having been secured by suitable adjustments of the principal moments of inertia. No change could be detected, but only rough observations were possible.

In the experiments on magnetization by rotation Maxwell's electromagnet is replaced by each one of the countless multitude of molecular magnets of which the magnetic body is constituted, and the total change in the orientations of all these magnets with reference to the axis of rotation of the body is determined magnetically.[8]

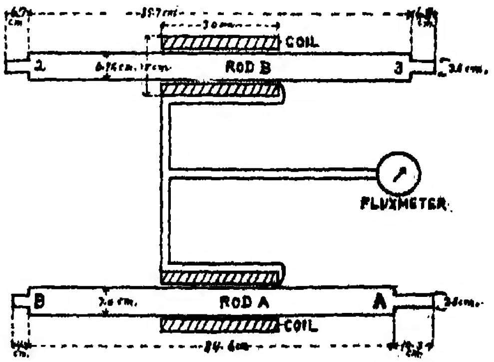


Fig. 3.

Two series of experiments have been made, both with Mrs. Barnett's assistance, and by methods as different from one another as possible. The first series of experiments was made

[8] I have learned very recently from a footnote in John Perry's *Spinning Tops* that he made experiments on this subject, with the same idea in mind, but without success, many years ago.

on large iron rods by a method depending on the principles of electromagnetic induction; the second, on smaller rods of iron, cobalt and nickel, by the method of the magnetometer. Recently a few preliminary experiments have been made on Heusler alloy.

Some of the essential parts of the apparatus used in the first investigation are shown in the diagram of Fig. 3.

Two nearly similar rods of steel shafting *A* and *B* were mounted with their axes horizontal and perpendicular to the magnetic meridian, and two similar coils of insulated copper wire were mounted about their centers. These coils were connected in series with one another and with a Grassot fluxmeter, which was the principal measuring instrument, and were oppositely wound so that that any variations in the intensity of the earth's magnetic field acting in the same way on both rods might produce

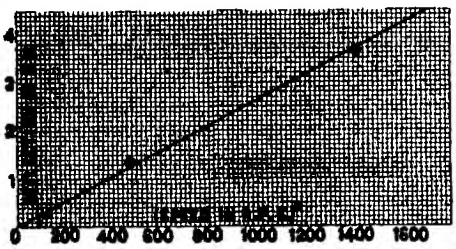


FIG. 4.

no effect on the fluxmeter. One of the rods, which will be called the compensator, as *A*, remained at rest; while the other, called the rotor, as *B*, was alternately rotated and brought to rest, the change of flux being determined by the fluxmeter, which, together with the other apparatus, was standardized by proper subsidiary experiments. For use in these experiments the rods *A* and *B* were uniformly wound with solenoids of insulated wire.

To prevent possible disturbances arising from the presence of the earth's magnetic field, the rotor was surrounded by a large electric coil which approximately neutralized the earth's intensity in the region occupied by the rotor.

The rotor was directly driven in either direction at will by an alternating current motor in part of the work, and by an air turbine in the rest.

In making observations fluxmeter deflections were obtained for each of several speeds, first with the rotation in one direction and then with the rotation in the other direction.

After making a great variety of tests, and after taking many precautions to eliminate sources of error, two effects stood out very clearly as the result of the observations, instead of the one which was looked for.

If the *mean* of the two deflections for the same speed is plotted against the square of the speed, the resulting graph is a straight line as shown in Fig. 4. The *mean* deflection is thus proportional to the square of the speed. This deflection is due to the increase of the residual magnetic flux through the rotor produced by its centrifugal expansion during rotation—an effect which was not foreseen, and which was

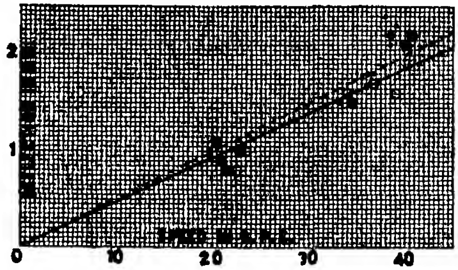


FIG. 5.

very puzzling until its explanation became apparent. This effect would vanish if the rod were completely demagnetized initially.

If, however, the *difference* between the two deflections for the two directions of rotation, instead of the mean deflection, is plotted against the *speed*, and not against the square of the speed, a straight line again results, as shown in Fig. 5. This is the effect which was under investigation. The straight line shows that H is proportional to N, as predicted.

The earlier experiments by this method gave for H/N the mean value -3.6×10^{-7} e.m.u.; the later and more precise experiments gave -3.1×10^{-7} e.m.u., with an experimental error for a set of four double deflections equal to about 12 per cent. The graph of Fig. 5 is drawn for these observations, the dotted

straight line corresponding to the weighted mean value of the double deflection divided by the speed.

Not long after the first conclusive experiments on magnetization by rotation were presented to the American Physical Society, Einstein of Switzerland and de Haas of Holland described successful experiments on the converse effect, viz., the production of rotation by magnetization, which had been predicted and looked for by O. W. Richardson in 1907, and they have since published additional experiments. Very recently another investigation of this converse effect has been made by J. Q. Stewart. All these investigations are indirect but excellent confirmations of the work described here.

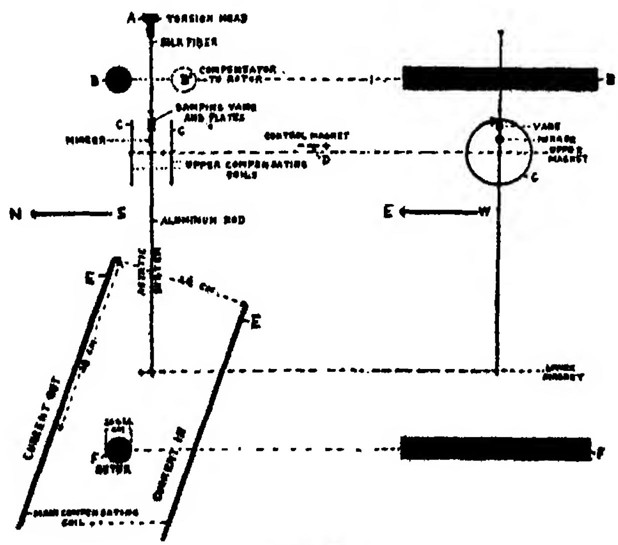


Fig. 6.

In the second investigation, as already stated, the method of the magnetometer was used. A diagram of important parts of the apparatus is given in Fig. 6.

The rod under test, or rotor, *F*, was mounted with its axis horizontal and normal to the magnetic meridian, as in the first investigation, and in the second, or equatorial, position of Gauss, which offered great advantages over the first, or polar, position for this work.

The magnetometer system, which was astatic, is shown suspended from the torsion head *A* by a silk fiber. To reduce disturbances due to variations of the earth's intensity as much as possible, a compensating rod *B* of the same substance and nearly the same size as the rotor, was mounted in approximately the same position with respect to the upper magnetometer magnet as that occupied by the rotor with respect to the lower magnet.

Possible errors due to induced currents in the rotor and to minute shifts of the rotor's axis in altitude or azimuth were avoided by compensating accurately the earth's intensity with the large electric coil *E*, as in the earlier investigation. *C* is a small electric coil in series with *E* to make the zero and sensibility approximately independent of the compensating current in the coil *E*.

The rotors were driven by an alternating current motor, operating at the same speed in both directions. Three different speeds of the rotor could be obtained by using cone pulleys.

The principal magnetometer observations consisted in getting the double deflections produced by reversing the direction of the rotation, the speed for the two directions being the same. From these readings, the speed, and the calibration experiments, *H*, could be found as a

function of N. Numerous precautions were necessary as in the earlier investigation.

The results of the observations on four rotors are given in Table I. The "set" of observations there referred to contained four readings, or two double deflections.

With nickel and cobalt observations were made at more than one speed; and H/N was found to be independent of the speed, within the limits of the experimental error, as in the earlier experiments with iron. It is also seen to be independent of the size and shape of the body in rotation, which is an implicit requirement of the theory developed above.

TABLE I

Intrinsic Magnetic Intensity of Rotation in Iron, Nickel and Cobalt

Rotor	Series	Groups	Mean Speed R.P.S.	Number of Sets	$-\frac{H}{N} \times 10^7$ E.M.U. Mean	Average Departure from Mean (Sets)
Steel (smaller)	1	1–2	44.8	21	5.1	0.5
Steel (larger)	2	3–4	47.8	21	5.2	1.2
Cobalt	3	5–7	20.2	17	4.8	2.2
	4	8–11	30.3	23	5.6	1.2
	5	12–25	45.5	79	6.0	0.9
	6	22	45.0	7	6.5	0.3
	7	24	44.8	9	5.9	0.4
	8	25	44.8	5	6.1	0.4
Nickel	9	26	20.5	4	4.7	2.0
	10	27–28	30.5	9	6.7	1.1
	11	29–32	45.3	37	6.1	0.5

The value of H/N is in all cases negative, but less in magnitude than that of the standard value of $4\pi m/e = -7.1$ e.m.u. for negative electrons in slow motion, as was the case in the earlier experiments with iron, which gave 3.6 and 3.1 in place of 7.1. In view of the experimental errors, it still seems to me doubtful whether these discrepancies indicate definitely that in addition to the negative electrons in orbital revolution there are also positive electrons revolving in orbits. The probability of the presence of the latter orbits is great from the known expulsion of α particles with great velocities from radio-active substances. There can be no question, however, that the effect of the negative electrons is at least greatly preponderant.

A few preliminary results, not of a precise character, but consistent with those of Table I., have been obtained with a rotor of very soft iron and with a rotor of Heusler alloy—a magnetic compound of aluminum, copper and manganese in atomic proportions.

In summing up the chief results of the two investigations it may be said that, in addition to revealing a second and entirely new method of producing magnetization in magnetic substances, they have proved in a direct and conclusive way, on the basis of classical dynamics alone and without dependence on the still obscure theory of radiation, (1) that Ampèreian currents, or molecular currents of electricity in orbital revolution, exist in iron, nickel, cobalt and Heusler alloy; (2) that all or most of the electricity in orbital revolution is negative, or at least that the effect of the negative electricity is preponderant; and (3) that this electricity has mass or inertia. Furthermore, if we admit the classical theory of radiation, according to which a ring of electrons moving in a circular orbit must continually emit energy, but at a smaller rate the more uniformly the electricity is distributed in the ring, we must conclude that the electrons are closely packed in the Ampèreian orbits. For the existence of residual or permanent magnetization proves that these orbits are essentially permanent and can not therefore emit energy at an appreciable rate.

S. J. BARNETT

THE OHIO STATE UNIVERSITY

THE ORIGIN OF THE PINK BOLLWORM

THE determination of the original habitat of the pink bollworm (*Pectinophora gossypiella* Saunders) is of great interest in relation to the present distribution of this insect and may be of importance later as indicating where parasitic or other natural checks may be found. A scrutiny of the records gives strong support to the theory that this insect originated in Southern Asia, probably India.

The first account of the insect by W. W.

Saunders[1] in 1842 accompanying its original description is based on specimens received from India, and the only information now available in relation to these specimens is an extract quoted by Saunders from a letter from a certain Dr. Barn, superintendent of the Government Cotton Plantations at Broach (Baruch) in western India. This extract is short and significant and is here given in full:

> The inclosed is an insect which was very destructive to the American cotton which was sown here (Broach), on light alluvial soil. The egg is deposited in the germen at the time of flowering, and the larva feeds upon the cotton seed until the pod is about to burst, a little previous to which time it has opened a round hole in the side of the pod for air, and at which to make an exit at its own convenience, dropping on the ground, which it penetrates about an inch, and winds a thin web in which it remains during the aurelia state. Curiously enough, the cotton on the black soil was not touched by it. The native cotton is sometimes affected by it.

This letter was addressed to a certain Dr. Royle who forwarded the specimens with this quotation from Dr. Barn to Mr. W. W. Saunders. In relation to this quotation, Mr. Saunders makes this significant comment:

> It is interesting to remark that the cotton grown from American seed is attacked in preference to any other and that the cotton plant when grown upon black soil remains free from injury. The former fact could be accounted for by the American cotton being of a different species to that usually grown in India and probably offers seeds which are more suitable to development of the larvæ.

The reason for the greater susceptibility of and damage to the American cotton is undoubtedly that suggested by Mr. Saunders and is supported by many similar experiences with introduced plants or introduced plant pests. The hardy and rather unproductive cottons of India and other southern Asiatic countries probably long associated with this insect evidently were then and are still fairly resistant to its attacks, and, on the other hand, the introduced American and Egyptian varieties are less resistant and perhaps furnish exceptional breeding conditions and were, therefore, when introduced into India and elsewhere in southern Asia, much more seriously attacked. This condition at once brought into prominence an insect which previously had been for the most part overlooked. It is significant that Dr. Barn should note that "native cotton is sometimes affected by it," indicating that it was a known but comparatively unimportant enemy of such cotton in India prior to 1842.

Saunders, in his article, makes no suggestion that the insect is other than a native Indian species, or, as has been stated by some writers, that it was imported with the American cotton. Responsibility for the theory of possible American at least African origin seems to rest with J. H. Durrant. This author, reviewing (1912)[2] the specimens of *Gelechia gossypiella* in the British Museum, summarizes the earlier Indian records with an evident strong mental bias toward an *inferred* American or Egyptian origin. An examination of these records indicates that there is no real warrant for this bias. Of the Indian record of 1842, quoted above, from Saunders, he suggests the importation of the insect with American cotton simply because of the excessive damage to this introduced variety in comparison with native cottons, ignoring the perfectly reasonable explanation of this condition advanced by Saunders. The records for Cawnpore (1883) and Lahore (1893–94) report damage to "cotton" but this "cotton" is *inferred* by Durrant to be Egyptian because from other sources he learned that some Egyptian cotton was being experimentally grown at or near these places and, similarly, another record from Surat, about which no information was available, is *assumed* by Durrant to have a similar history.

August Busck (1917),[3] following Durrant, without critical examination of the latter's data, accepts his general conclusions, and expresses the belief from this "evidence," and

[1] Saunders, W. W., *Trans. Ent. Soc. London*, Vol. III., pp. 284–85, 1843.

[2] Durrant, J. H., *Bul. Ent. Research*, Vol. III., Pt. 2, pp. 203–06, Fig. 1, London, 1912.

[3] Busck, August, *Jour. Agric. Research*, U. S. D. A., Washington, Vol. IX., pp. 343–70, 6 pls., 1917.

certain insect relationships which will be noted below, that Africa is indicated as the original home of the ping bollworm.

The support of this theory of African origin based on the fact that the only near relative of the pink bollworm, *P. malvella* Zeller, is known from Africa as well as Southern Europe should be given very little weight, inasmuch as a more accurate knowledge of the distribution of this related insect may show it to range, as it probably does, throughout southern Asia in addition to its now known range in Africa and southern Europe. In fact, it would be most astonishing that an insect having a range already as wide as that indicated, should not occur also in contiguous Asia, and, furthermore, entomological collections and explorations in Asia have not been made with any such thoroughness as to give this argument any substantial support.

On the other hand, Fletcher (1917),[4] reviewing the pink bollworm situated in India, states that "*Gelechia gossypiella* occurs throughout the plains of India, Burma and Ceylon, as a pest of cotton, serious in most localities, especially in the United Provinces, Punjab, and the Northwest Frontier Provinces. In all districts exotic varieties seem to be most subject to attack." He further notes that "*Gelechia gossypiella* was first described from India in 1842, and is probably endemic in India. It has since been introduced into other cotton-growing areas and has proven a serious pest, apparently worse than it is in India as a whole."

In this connection it is interesting to note that the record, as reported by Durrant,[3] indicates a wide distribution of the insect throughout southern Asia, including India, Ceylon Berma, Straits Settlements, Philippines, Japan (?) and Hawaii—records, most of them, antedating from eight to seventy years, the first report of the insect in Egypt.

Looking at the question, also, from the standpoint of cotton culture in Egypt, if it is true, as has been so strongly urged, that this insect is of African origin, and reached India from Egypt, it must follow that during the last seventy-five or one hundred years, it has had ample opportunity to demonstrate in Egypt, throughout the whole period, its maximum destructiveness. The record of the cotton crop in Egypt up to and subsequent to the first recognition of the pink bollworm in 1911 certainly gives no support to the theory of Egyptian origin; on the other hand, the evidence of its recent entry into Egypt as given by Ballou[5] and others is circumstantial and practically determined, both as to time and place of introduction. Briefly, there were large importations of imperfectly ginned or of seed cotton from India in the years 1906 and 1907. Much of this cotton was distributed to towns near Alexandria for ginning. The discovery of the pink bollworm in the Delta region in Egypt was in the lower Delta, in the vicinity of towns where this seed cotton went for ginning. It was first noted in 1911 at Foueh, and in the following year at four other points, three of which were very close to Foueh. The first substantial general field injury observed from this insect was in 1912 near Alexandria. By the end of that year, 1912, however, the insect was found pretty well throughout the Delta and also north of Cairo to a distance of a hundred miles or more, but in no case except the one field referred to was it abundant enough to do any material injury. The increase of the damage in Egypt by this insect from that period has been steady in spite of the enforcement of the most strenuous field and other control operations.

The possibility of the importation of this insect from India with a large quantity of cotton seed imported into Egypt in 1906–7 is perfectly patent in view of the known occurrence of this insect in India for three quarters of a century.

From the evidence, herein reviewed, it would seem to be well established that the native home of the insect included India and perhaps other countries of southern Asia. If its natural range extended to Africa it must

4 Fletcher, T. Bainbrigge, Rep. Proc. Sec. Ent. Meeting. Pusa., February, 1917, pp. 10, 111–14, 1917.

5 Ballou, H. A., *Jour. Econ. Ent.*, Vol. XI., pp. 236–45, 1918.

have been limited to equatorial Africa and certainly it had not reached prior to 1906 or 1907 the cultivated district of the Nile Valley where cotton has been a commercial crop of importance for at least a hundred years. This point of view is now held by the experts who have studied this insect in Africa and India such as Willcocks, Fletcher and Ballou.

C. L. Marlatt

HARRY KIRKE WOLFE

Professor Harry Kirke Wolfe, head of the department of philosophy in the University of Nebraska, died suddenly on July 30 last at Wheatland, Wyoming, whither he had gone for a brief outing. Dr. Wolfe was born in Illinois, in 1858, but he was a Nebraskan by rearing and he received his collegiate education in the state university. In 1883 he went to Berlin to carry further the study of the classics, which was then his interest, but while in Germany he was won to psychology, and changing to Leipzig became one of the group of young Americans who had been attracted by the fame of Wilhelm Wundt, and who were to revolutionize the teaching of the science upon their return to America. Dr. Wolfe was in the vanguard of this movement. He received his doctorate in 1886, and in 1889 he was made professor of philosophy in his alma mater, where previously this field had been the prerogative of the college head. Immediately he began to build up the physiological and psychophysical foundations of his subject, creating the first laboratories in psychology open to undergraduates in the country—a feature of the instruction which to the end was distinctive of his work. From 1889 to 1897 Dr. Wolfe's work was attended with a truly phenomenal success, not only in the immediate strength of his department but also in its influence, for he started not a few young men toward the advanced cultivation of his science—among them Professors Pillsbury of Michigan and Bentley of Illinois—as well as of the broader field of philosophy. It was in this period, too, that he published a number of monographic articles in psychophysics (out of a great series planned), and he was connected with the appearance of the *American Journal of Psychology*. Unhappily the career thus splendidly begun was interrupted by one of those accesses of bigotry which sometimes seize college authorities; and under absurd political and religious charges he was asked to resign in 1897. In the period from 1897 until 1905 Dr. Wolfe was engaged in public school work, with the result that his interest in secondary education became the predominant one for the remainder of his life. In 1905 he was called to the University of Montana, and two years later back to the University of Nebraska, where again he became head of the department which years before he had founded. This position he held until his death. In this latter period, while his old interest in experimental psychology was as keen as ever, it had constantly the bias of the secondary school needs in mind, and his laboratories became the training grounds for scores of young men and women who were to enter the public school field. Certainly there are few, if any, teachers in the middle west who have so profoundly and beneficially influenced the later development of its secondary education.

Such in brief is the outward career of a man whom all who knew him knew to be possessed of a genius for teaching. There are few qualities which the teacher should possess which he did not own in exalted measure: keenness and kindness, unfailing humor and patience and generosity of soul, and the power to inspire, all these were his; and he was loved by those under his influence as few men are loved. It is an irony—perhaps attaching to his quiet yet steadfast personality, for he was above all a man of principle—that such a man should twice in his career have come under the charges of malicious ignorance. The first occasion was in 1897. Ten years later, when he was returned to his old position his vindication came (as it was bound to come), though meantime the character of his life work had been once for all altered. The second occasion was in June of 1918, when through idle gossip his name was dragged before the inquest into loyalty forced upon the university by the State Council of Defense. He was, of

course, immediately vindicated; but the cruel fact of the charge was a hurt which—humorously as he passed it off—made the more precarious the heart trouble from which he suffered, and led quickly to the end. Dr. Wolfe was one of the few men to whom, in action and motive and principle, the word "noble" can be clearly applied. He was a lover of truth and righteousness, of his country and of humanity, and of the best in all things—worthy of the name of philosopher.

HARTLEY B. ALEXANDER
UNIVERSITY OF NEBRASKA,
September, 1918

SCIENTIFIC EVENTS

THE DEVELOPMENT OF THE DYESTUFFS INDUSTRY

THE success of the American chemists and chemical manufacturers in developing the dyestuffs industry, when the supplies of dyes from Germany were cut off, is shown in a report issued by the United States Tariff Commission, entitled "Census of Dyes and Coal-tar Chemicals, 1917."

At the outbreak of the European war, Germany dominated the world's trade in dyes and drugs derived from coal tar. Before the war, seven American firms manufactured dyes from imported German materials. In 1917, 190 American concerns were engaged in the manufacture of dyes, drugs and other chemicals derived from coal tar, and of this number 81 firms produced coal-tar dyes from American materials which were approximately equivalent in total weight to the annual imports before the war. The total output of the 190 firms, exclusive of those engaged in the manufacture of explosives and synthetic resins, was over 54,000,000 pounds with a value of about $69,000,000.

Large amounts of the staple dyes for which there is a great demand are now being manufactured in the United States. A few of the important dyes, such as the vat dyes derived from alizarin, anthracene and carbazol, are still not made. The needs of the wool industry are being more satisfactorily met than the needs of the cotton industry.

The report gives in detail the names of the manufacturers of each dye or other product and the quantity and value of each product, except in cases where the number of producers is so small that the operations of individual firms would be disclosed. Seventeen hundred and thirty-three chemists or engineers were engaged in research and chemical control of this new industry, or 8.8 per cent. of the total of 19,643 employees. The report also contains an interesting account of the history and development of the industry since the outbreak of the European war.

On August 27, Dr. H. O. Forster, a member and director of the Technical Committee of British Dyes, Limited, lectured on August 27 on "The decay and renaissance of British dye making" at the British Scientific Products Exhibition, King's College. He stated that in 1878 the color industry in Germany was four times as valuable as that of England. Of £3,150,000 worth of coal tar colors produced in the world Germany produced £2,000,000, four fifths of which was exported, while Switzerland produced £350,000, and England only £450,000 worth.

That was forty years ago; confronted by these figures, people would hesitate to believe those who said that in two or three years England should be able to do all that Germany could in regard to the dye industry. It would take ten or fifteen years of unremitting labor and extraordinary patience and liberal expenditure on chemistry before we could hope to achieve the position which Germany had reached before the war in this industry. He said in conclusion:

> They have three times as many chemists as we have, and their population is half as large again. We shall have to make a great effort if we are going to reach them. The industry is not an El Dorado in which one has to dig once in order to make countless thousands. It can only be achieved if money is spent on experiment. That was how Germany got on, and unless we tread the thorny path the Germans have followed, there is not the slightest hope of our catching them up in this industry. They will keep it for all time.

On the conditions of success in England Sir Henry Armstrong writes to the London *Times:*

The action taken by a large majority of the shareholders of British Dyes (Limited) at Huddersfield practically involves determining the existence of the government company as a separate business and placing the technical management in the hands of Dr. Levinstein.

Not a moment should be lost in the necessary reconstruction. Mr. Norton stated at the meeting that it was proposed "there should be three directors appointed by the shareholders of each company and three by the government, so that it would always be possible for the state to stop any abuse." The number is too large, and to give the government control of a scientific enterprise is simply to ask for disaster—the four years of failure of the company under such control should at least have taught us this much.

In the next place, it must be recognized that science must be of and at the works. All laboratory operations should at once be transferred to the factory. One of the main functions of the research department in German works—that to which more than to any other they owe their peculiar efficiency—has been that of a training school for the works. One of the chief reasons of the government company's lack of success has been the absence of sympathy between the works and those who were carrying on scientific inquiry for the company outside the works, as well as the failure to develop an efficient works staff. There has been much loose talk during the past four years with regard to cooperation between the university and industry; the real function of the university must be to serve as the training ground for industrial workers, and the sooner the professoriate learn to apply themselves wholly and solely to this form of industry the greater will be our progress as a country.

Thus far, in their attempt to nurse the dye-stuff industry into existence, government has made use of entirely unskilled agents—and, as was to be expected, the failure has been complete. If any further effort is to be made by the state, let it be a rational one. Unless and until the Board of Trade and the so-called Controller of Dyestuffs be aided by a scientific advisory board, injury rather than advantage must result from further state interference.

HEALTH MISSION TO ITALY UNDER RED CROSS AUSPICES

The War Council of the American Red Cross has announced the personnel of the medical unit to conduct a health campaign in Italy with the stamping out of tuberculosis as its particular objective. The Italian tuberculosis unit of the American Red Cross, as the organization will be known, will be under the supervision of Colonel Robert Perkins, Red Cross commissioner for Italy.

Included in the personnel of the unit, which numbers 60 persons, are many of this country's best known tubercular specialists, as well as physicians who have been successful in the lines of work which they will be called upon to perform. The director of the unit is Dr. William Charles White, of Pittsburgh. Others are: Dr. John H. Lowman, professor of clinical medicine at Western Reserve University, Cleveland, chief of the medical division; Dr. Louis I. Dublin, of New York, statistician of the Metropolitan Life Insurance Co., chief of the division of medical statistics; Dr. Richard A. Bolt, of Cleveland, connected with the health department of that city, chief of child-welfare division; Dr. E. A. Paterson, of Cleveland, chief of division of medical inspection of public schools; Dr. Robert G. Paterson, of Columbus, Ohio, head of the tuberculosis branch of the state health department, chief of the division of education and organization; Miss Mary S. Gardner, head of the bureau of public-health nursing of the American Red Cross, chief of division of public-health nursing. The executive manager of the organization is Lewis D. Bement, of Framingham, Mass.

Dr. White, who was director of the Red Cross tuberculosis unit in France for ten months, made the following statement concerning the situation in Italy:

> It must not be thought that the United States is sending this delegation because Italy is backward in this respect. As examples of Italian work one may cite the situation in the city of Genoa, which for many years, probably over twenty, has had a museum showing the various phases of tubercular diseases, as well as modern methods of combating them. Campaign and educational literature are there for distribution among the people. Attached to the museum are a dispensary and visiting nurses' school not surpassed in any of the American cities.
>
> In Genoa also is an attractive open-air school.

In the middle of the enormous sea wall, of primitive structure, with the surf washing against the wall below it and protected from the winds of the north by the wall itself, in constant sunshine, provision is made for 200 or 300 Genoese children of the more unfortunate classes. They arrive in the morning, get their midday meal and morning luncheon, and are sent to their homes in the evening. Play is supervised by special teachers, bathing facilities arranged for; the children take singing lessons and a healthier, happier looking lot of children one could scarcely find.

When we visited them in February they sang the Italian national anthem and "The Star Spangled Banner" with vigor and enthusiasm. There are also children's hospitals in the mountains. In Rome the *Giornale d'Italia* raised money by popular subscription and built a beautiful hospital on one of the hills for children with bone tuberculosis.

The American Red Cross had the privilege of giving $25,000 to this hospital. These are just a few conspicuous instances of what the Italians have already done for the study and cure of tuberculosis.

But Italy's great spirit for progression was arrested with the declaration of war, which compelled the mobilization of all her resources for the one big task in hand. It naturally followed that the civilian population had to wait until the military needs were cared for.

Then, as in France, this emergency was created. Conditions were growing harder to grapple with each day. When Italy saw the help we were extending to France she invited the United States to come to her shores with such assistance as we could offer.

CIVIL SERVICE EXAMINATIONS

THE United States Civil Service Commission announces open competitive examinations as follows:

List No. 1. Examinations of the nonassembled type; that is, those in which competitors are not assembled for scholastic tests, but are rated upon the subjects of education, training and experience, and corroborative evidence. Applications for these examinations are received at any time: Inspector of mechanical or electrical equipment, inspector of structural steel, supervising or traveling accountant, construction cost accounting supervisor, automotive engineer, automotive designer, automotive draftsman, automotive tracer, mechanical draftsman, War Department; special field agent in entomology, Department of Agriculture; tabulating mechanician, Census Bureau; elevator conductor, departmental service.

List No. 2. Examinations of the nonassembled type, for which applications must be filed by the dates specified: Horticulturist, Department of Agriculture, September 17; architectural designer, architectural draftsman, Panama Canal Service, September 17; photographer, War Department, September 24; mechanical draftsman, Patent Office, September 24; assistant in dairy cattle breeding, assistant in fish investigations, assistant superintendent of seed warehouse, Department of Agriculture, September 24; sugar chemist and technologist, Bureau of Standards, September 24; assistant clinical psychiatrist and psychotherapist, St. Elizabeths Hospital, September 24; chemical laboratorian, chemist's aid, various branches, September 24.

List No. 3. Examinations in which competitors will be assembled for scholastic tests: Laboratory aid in agricultural technology, Department of Agriculture, October 2; business principal, Indian Service, October 2–3; inspector of safety appliances, inspector of hours of service, Interstate Commerce Commission, October 2–3.

Full information and application blanks may be obtained by addressing the United States Civil Service commission at Washington, D. C., or the civil-service district secretary at Boston, New York, Philadelphia, Atlanta, Cincinnati, Chicago, St. Paul, St. Louis, New Orleans, Seattle, or San Francisco.

SCIENTIFIC NOTES AND NEWS

MAJOR GENERAL WILLIAM C. GORGAS, Surgeon-General, U. S. A., accompanied Secretary Baker on his recent visit to France.

COLONEL JOHN M. T. FINNEY, Baltimore, who returned to this country early in August on a special mission, has again sailed for France to assume his duties as chief consultant surgeon of the American Expeditionary Forces.

Dr. H. S. Washington, of the Geophysical Laboratory of the Carnegie Institution, has been appointed chemical associate to the scientific attachés at the American embassies in Paris and Rome.

Professor Graham Lusk, of Cornell Medical College, and one of the representatives at the recent meetings of the "Interallied Scientific Food Commission" abroad, will give at the New York Academy of Medicine on Thursday evening, October 3, at nine o'clock, the Wesley M. Carpenter lecture on "The scientific aspect of the interallied food situation."

Dr. William P. Harlow, head of the school of medicine of the University of Colorado, has been appointed a major in the Medical Corps, and has been placed in charge of General Hospital No. 21.

Dr. H. L. Hollingworth, associate professor of psychology in Barnard College, Columbia University, has been commissioned a captain in the Sanitary Corps, and will report at the Plattsburg Barracks.

Rhys D. Evans, associate professor of physics in Bowdoin College, formerly instructor in physics, Ohio University, Athens, Ohio, the son of Professor D. J. Evans, of the latter institution, has been commissioned captain in the Chemical Warfare Service.

Dr. W. E. Carroll, professor of animal husbandry at the Utah Agricultural College, has been commissioned as captain in the Sanitary Corps of the United States Army, and will report to Fort Oglethorpe, Georgia, for special training at the medical officers' training camp.

Dr. W. L. Argo, formerly of the University of California, has been commissioned a lieutenant in the Chemical Warfare Service and has been sent to France.

Dr. W. J. Robbins, formerly professor of botany at the Alabama Polytechnic Institute, has been appointed a lieutenant, Sanitary Corps, and is stationed at Yale University.

John Paul Givler, of the department of zoology, University of Tennessee, has been appointed first lieutenant in the Sanitary Corps.

Dr. Frank C. Gates, professor of biology at Carthage College, Carthage, Ill., has been commissioned second lieutenant in the Sanitary Corps and reported at Yale University on September 9.

Lieutenant Charles A. Waters, who recently returned to this country after fourteen months' service with the Johns Hopkins Base Hospital in France, will leave shortly for Fort Oglethorpe, Ga., where he will be an instructor in the roentgen-ray division of that cantonment. He expects to return to France later.

O. L. Thomas has been transferred from the Experimental Station of E. I. du Pont de Nemours and Co., Wilmington, Del., where he acted as research chemist, to the U. S. Government Powder Plant at Jacksonville, Tenn., where he will be chief supervisor of caustic soda manufacture and soda ash recovery.

The Mary Kingsley medal of the Liverpool School of Tropical Medicine for research in tropical diseases has been awarded to Dr. Griffith Evans, the discoverer of the trypanosome of Surra, a disease of horses and camels of India, Burma, and the east.

Dr. Caroline S. Finley, Dr. Anna I. Von Sholly and Dr. Mary Lee Edward, of New York, who are connected with the Women's Overseas Hospitals, have been decorated by the French government and commissioned lieutenants in the Medical Corps of the French Army, the commissions having been bestowed for excellent surgical work and treatment of the wounded under heavy bombardment in a hospital at the French front.

R. G. Webber, assistant professor of physics, Ohio University, Athens, Ohio, who has been in the service of the government during the summer at the Watertown Arsenal, has had his leave of absence extended through the coming college year to continue his work in the physical testing department of the arsenal.

Professor C. H. Gordon, Ph.D., professor of geology and mineralogy, University of Tennessee, has returned after an absence of two weeks in lecturing at army camps under the auspices of the Army Y. M. C. A. The

first week was spent at Camp Hancock, Augusta, Ga., and the second at Camp Sevier, Greenville, S. C. The plan of giving lectures in the camps on geographical and travel subjects was undertaken at the instance of the committee on geology and geography of the National Research Council, of which Professor W. M. Davis, of Harvard University, is chairman.

Dr. D. S. Jenings has been appointed to the staff of the Experiment Station of the Utah Agricultural College as expert in charge of an extensive soil survey to be made of the state of Utah. This survey will be conducted in consultation with the station departments of agronomy, geology, horticulture, irrigation and drainage, botany, chemistry and bacteriology, and farm management.

Professor A. S. Hitchcock, Bureau of Plant Industry, spent the month of August studying and collecting grasses in Arkansas, Oklahoma, Texas and Colorado.

Dr. Ira E. Lee, instructor of chemistry at the University of Rochester, has become a research chemist with E. I. du Pont de Nemours & Co., Wilmington, Del.

Dr. Alfred R. Schultz has presented his resignation from the U. S. Geological Survey, to become manager of a hydro-electric power and milling company.

Mr. John A. Coye has resigned his position as chief chemist with the Engineering Experiment Station of the Iowa State College, Ames, Iowa, to accept the position of assistant chemist with the General Chemical Company at their Laurel Hill Works.

Professor Joji Sakurai, who has arrived in London from Japan, has brought with him a contribution from Japan to the Ramsay Memorial Fund, amounting to £487 9s. 2d., which he has handed over to the honorable treasurers, Lord Glenconner and Professor Collie.

UNIVERSITY AND EDUCATIONAL NEWS

The movement for reform in the management of the universities in Argentina for which the professors and students of the universities have been keeping up an agitation, has culminated in a bill presented by the president of the republic to congress for deliberation and action. The bill coincides in general with the demands of those contending for reforms. It provides that the dean shall be elected by the professors, he shall serve four years and can not succeed himself. The election will be by a council of seven members, one representing the students, one the alumni and the others the professors.

At Harvard University, Dr. Wallace Clement Sabine has been appointed acting director of the Jefferson Physical Laboratory, and Dr. Herbert Sidney Langfield, acting director of the Psychological Laboratory.

Professor Louis de L. Harwood, Montreal, has been appointed dean of the medical department of Laval University.

F. C. Werkenthin, assistant professor of biology in New Mexico College of Agriculture and Mechanic Arts, has been elected to the associate professorship of botany in New Hampshire Agricultural College and will assume his new duties with the opening of college in September.

At Cornell University Dr. R. C. Gibbs has been promoted to be professor of physics; Dr. H. E. Howe, formerly professor of physics at Randolph-Macon College, has been appointed assistant professor.

Dr. H. L. Walster, of the college of agriculture of the University of Wisconsin, Madison, Wisconsin, has returned to his position as associate professor of soils in the university after having spent a year's leave of absence at the University of Chicago, where he received the Ph.D. degree in plant physiology and plant ecology.

The following changes in the faculty of the department of agriculture in the University of Minnesota have been made recently: H. H. Kildee has resigned as chief of the dairy husbandry division in order to take charge of animal husbandry work at Iowa State College,

and has been succeeded by C. H. Eckles, formerly of the University of Missouri; J. S. Montgomery and T. G. Paterson have resigned as associate professors of animal husbandry, and R. C. Ashby as assistant professor of animal husbandry, to enter commercial work; W. H. Peters, formerly head of animal husbandry of the North Dakota Experiment Station, has been appointed professor of animal husbandry; P. A. Anderson has been promoted from instructor to assistant professor of animal husbandry; J. C. Cort, formerly of Iowa State College, has been appointed assistant professor of dairying.

DISCUSSION AND CORRESPONDENCE

RED RAYS AND PHOTOELECTRIC EFFECT

I WISH to call attention to an error which should be corrected as it is being repeated and found its way into such standard texts as Hughe's "Photoelectricity" (Cambridge University Press). Red light does *not* give a photoelectric effect with phosphorescent calcium sulphide, as the effect stops at the wavelength of about 4,200 Ångström, as was shown by the writer.[1] This result was later confirmed at the University of Berlin. The result is of considerable theoretical importance because the theory of the photoelectric effect which takes into account the necessity of a critical energy content before the electrons can be shot off, shows that there will be a wavelength for each element beyond which no photoelectric effect will be produced. The element which gives the photoelectric effect in phosphorescent calcium sulphide is not known, but has been supposed by the writer to be sulphur as it is photoelectric for ultra-violet light and it was shown experimentally to give a photoelectric effect for wave-lengths *longer* than 3,200 Ångström. This hypothesis could be established by showing that the photoelectric effect of sulphur ended at the same point as was shown for phosphorescent calcium sulphide.

When the writer began an investigation of the photoelectric effect of phosphorescent material in 1910 at Yale University, it was *supposed* that the result obtained in 1909 by Lenard and Saeland at the University of Heidelberg was correct. However, it was found that the photoelectric effect of phosphorescent calcium stopped at about 4,200 Ång., which is a shorter wave-length than red light. Thus the result of Lenard and Saeland is incorrect.

The error arose from confusing the effect of red light on the conductivity, which did exist, with that of the photoelectric effect which did not exist. In their paper in the *Annalen der Physik*, Lenard and Saeland described what they thought to be a new effect with red light which was called "Aktinodielektrische Wirkung." This effect differed from the photoelectric effect in that the test plate instead of charging up only positively, charged up both positively and negatively. It was thought that the long heat or red waves being more nearly comparable with the dimensions of the molecules affected them beyond the point where the photoelectric effect stopped. However, after working about a year on the effect of red rays on phosphorescent calcium sulphide, the writer came to the conclusion that no photoelectric effect could be obtained with red light and that the actinodielectric effect was nothing more than an increase in conductivity such as had previously been known to exist for selenium.

After the foregoing conclusion was reached a reexamination of the original article of Lenard and Saeland showed that on account of a faulty construction of their apparatus the plate on which the material was placed was not completely insulated from the accelerating and retarding fields, as is necessary when the photoelectric effect only is to be obtained.

In order to confirm the conclusion, my own apparatus was later reconstructed at the Massachusetts Agricultural College so as to obtain both effects separately at will. It was shown with this apparatus that sulphur was both photoelectric and actinodielectric. The photoelectric effect required a high vacuum, but the actinodielectric effect worked in addition at atmospheric pressure, the direction of the current depending upon the direction of the applied field.

[1] "The Photoelectric Effect of Phosphorescent Material," *American Journal of Science*, 1912.

The conductivity of phosphorescent calcium sulphide was later separately investigated at the University of Heidelberg, and it was shown that certain wave-lengths not in the infra-red gave a maximum effect, which was contrary to what one might have expected from Lenard's theory. Rather the effect was a maximum near the point where the photoelectric effect stopped, suggesting some relation between the photoelectric and actinodielectric effect. An investigation of the relation between these two effects (which amounts to finding out the relation between the ease with which the electrons are ejected and the increase in conductivity for different wave-lengths of light) was started for sulphur, during the summer of 1913, by the writer at the Davy-Faraday Research Laboratory of the Royal Institution, London, England, but was not finished.

The relation between the photoelectric effect, actinodielectric effect and phosphorescence has been discussed by the writer and a general theory of phosphorescence has been developed which includes fluorescence, fluorescent X-rays, organic phosphorescence and self-luminous radioactive substances.[2] In the review of this theory in the "Beiblatter zu den Annalen der Physik" the difference between Lenard's theory of phosphorescence and the author's is not clearly pointed out. The author's theory takes into account resonance, Stokes's law and a critical energy content, which is not done by Lenard.

In conclusion, in respect to phosphorescent calcium sulphide, it should be said that red light does increase its conductivity, but *does not* give a photoelectric effect.

Chester Arthur Butman

[2] See "The Electron Theory of Phosphorescence," *Physical Review*, 1912.

SPECIAL GROWTH-PROMOTING SUBSTANCES AND CORRELATION

The vigor of potato sprouts bears a direct relation to the size of the seed piece, or in other words to the amount of tissue surrounding the eye. When a certain minimum is reached, the vigor of the sprouts decreases as the size of the seed piece is reduced. The weak, slender sprouts produce correspondingly weak plants which remain weak during their entire period of growth and yield a small crop of tubers.

The weak sprouts are not due to lack of usual food materials, as sprouts on pieces still large enough to contain an abundance of these substances, show considerable decrease in vigor. If a lack of sufficient ash constituents is responsible for the weak sprouts, they might be expected to approach their usual vigor if the small pieces be allowed to sprout in rich soil, as the sprouts form roots very quickly in moist soil. The sprouts from such pieces, however, do not gain any vigor under these conditions.

It seems logical to conclude that the potato tuber contains a limited amount of a special growth-promoting substance and if the amount of tissue surrounding the growing bud is too small, there is not enough of this substance available for normal growth.

Some of the experimental data is included in Bulletin No. 212 of the Maryland Agricultural Experiment Station under the following title: "Physiological Basis for the Preparation of Potatoes for Seed." While this bulletin was in press an article appeared by Loeb, in which he states that equal masses of sister leaves of *Bryophyllum calycium* produce approximately equal masses of shoots in equal time and under equal conditions, even if the number of the shoots varies considerably. He concludes that the limited amount of material available for growth and the automatic attraction of the material by the buds which grow out first, explain the inhibiting effect of these buds on the growth of the other buds.

If the correlative inhibition of bud growth on the potato tuber has a chemical basis it does not appear to be identical with the growth-promoting substance which the writer has postulated and which seem to effect the growth of sprouts only after they have started. Several facts in connection with the growth of sprouts on potato tubers could be mentioned to substantiate this conclusion but the two following experiments seem sufficient.

If a potato tuber bearing vigorous sprouts on the terminal end is cut transversely into

halves, sprouts will appear on the basal half. Therefore, this half still contained sufficient growth material to produce sprouts. This proves that, although the basal buds would not grow out before their connection with the terminal end of the tuber was severed, they were not prevented from doing so because the terminal sprouts had automatically attracted the limited amount of material for growth.

If a tuber, before the end of the rest period, is cut into transverse slices the buds on the basal slices will grow out first. If the tuber is cut lengthwise into fractions the growth of basal buds is entirely suppressed. The terminal buds on these fractions do not produce sprouts until the end of the natural rest period for whole tubers, which in some cases is a month after the basal buds on the transverse slices have grown out. The basal buds seem to have a shorter rest period than the terminal ones but are unable to grow out until their connection with the terminal end of the tuber is severed. This experiment shows that the terminal end of the tuber, even before its buds have grown out, may inhibit the growth of buds more basally situated.

Potatoes are sometimes affected with a physiological disease called "Spindling Sprout," because the whole tubers produce long, slender, weak sprouts. In all probability the special growth-promoting substances are abnormally low in these tubers. In this connection, however, the most interesting symptom of the disease is a lack of any inhibiting effect of the terminal buds on the other buds, as the sprouts appear, as a rule, simultaneously over the entire tuber. The behavior of the *Bryophyllum* plants reported on by Braun[1] may have been due to a condition of the particular plants analogous to the "Spindling Sprout" of the potato. If this were true it would account for the instances of regeneration of *Bryophyllum* leaves seemingly at variance with the experiments described by Loeb.[2]

Charles O. Appleman

Maryland Agricultural Experiment Sta., College Park

[1] Braun, Lucy E., *Bot. Gaz.*, 65, 191–193, 1918.

[2] Loeb, J., *Bot. Gaz.*, 65, 150–174, 1918.

QUOTATIONS

THE MEDICAL PROFESSION IN GREAT BRITAIN AND THE WAR

The effect of the war upon the number of medical students in their different years of professional study has been described from time to time by the president of the General Medical Council. Between the years 1910 and 1914 the annual entry of first-year medical students averaged roughly 1,440. Since the war the number of these entries has increased by five or six hundred a year. Thus the whole number of students actually pursuing medical studies in the medical schools of the United Kingdom has shown a steady upward movement. In May, 1916, the total was 6,103, in January, 1917, it was 6,682, in October, 1917, it was 7,048, while the latest figure, for May, 1918, was 7,630. But for some time the larger withdrawals of male students from the medical schools for combatant service or for service as surgeon probationers in the navy, more than nullified the increased entries and bade fair to produce a serious deficiency of new practitioners in the years 1918 and 1919. Urgent representations upon this matter were made to the government. As a result something has been done to make good the threatened shortage by the return of third-year students from active service to complete their studies, by the retention in the medical schools of students on their way towards qualification who are liable to be called to the colors, and by limiting the period of service of surgeon probationers. The Minister of National Service has further undertaken to provide that, if possible, the supply of students in training shall be kept at a level sufficient to give an annual yield of at least 1,000 new practitioners. This is the official estimate, but it will be well to remember that though there has been heavy wastage among medical men through the hazards and hardships of war the declaration of peace will be followed by the release from military duty of the majority of the medical men now serving in the army and navy. Demobilization is a matter which effects the medical profession at least as much as other sections of the community. The method in

which the demobilization of medical men may best be carried out is being carefully studied by the British Medical Association. They will no doubt be released gradually as the other branches of the army are demobilized, but many will be eager to return to civil life, and in any estimate of the numbers of the medical profession in this generation regard must be had to the fact that during the last three years practically all newly qualified practitioners have been taken into the army. Within some not very long time after the conclusion of war many of them will be liberated to return to civil life, and will naturally and properly have the first claim upon the public and upon pubic authorities.

Another feature of the last four years has been the great increase in the number of women going in for the study of medicine. In May last there were 2,250 women medical students in the United Kingdom—a figure 23 per cent. greater than the total for January, 1917, and several times larger than in 1914. For this remarkable growth the war must be held mainly responsible. As for the professional instruction of these large numbers of students, men and women alike, there can be no doubt that the war by diverting the activities of many of their teachers into other channels or other spheres has considerably depleted the staffs of the medical schools as well as of other educational institutions in which the preliminary subjects and various branches of medical science are taught. Nevertheless, the teachers who continue at their posts are making every effort to maintain the standard of instruction, in spite of war-time difficulties.

What will be the prospects of the medical profession when the war is over? The medical services have acquitted themselves extremely well in the war, and medical science will come out of it with an enhanced reputation. Military medicine and surgery have advanced, and not a few of the results of practise and research in the war zones will remain as permanent additions to knowledge. The treatment of wounds has steadily improved, orthopedic treatment for the crippled and maimed is more successful than ever; preventive medicine in camp and trenches has scored great triumphs; the work of the pathological laboratory and of the bacteriologist has proved to be of the utmost value. In civil life the spirit of the times is all in favor of extension and coordination of the public health services. This is reflected in the widely-supported proposal for the setting up of a Ministry of Health, which has received fresh impetus during the past few months. The Minister of Reconstruction, according to rumor, has had a draft bill in his pocket since the beginning of the year, but it does not appear to have won the approval of the Committee of the Cabinet on Home Affairs. The possibilities of the future are large, but as yet ill defined. More medical care has been provided for expectant mothers, for infants, for children, and for the victims of venereal diseases; a great increase in the public work of pathological laboratories all over the kingdom may be confidently expected. All this means an increase in the official medical services. What ultimate fate is in store for the private practitioner we will not venture to foretell. Before the war, as we have pointed out above, his position had been profoundly affected by the Insurance scheme which converted the majority of general practitioners into part-time civil servants and subjected them to the discipline of Insurance Commissioners. Pecuniarily it has benefited some and impoverished others. One thing at least can be said: the immediate future is full of uncertainty, especially for the general practitioner. Forces which had long been at work beneath the surface have gained strength through the circumstances of war and many believe that the state will gradually tighten its grip on the medical profession.

Every doctor should possess a strong sense of *esprit de corps*. Medicine is a profession which, when it comes to business dealings of any sort, the general public—as also public authorities—persistently regard as being of a semi-philanthropic character. Furthermore, it is a profession whose aims and requirements are very ill understood by persons who have not undergone a medical education. Hence the interests of the medical profession, both on its financial and scientific sides, are continu-

ally being attacked, sometimes openly, sometimes insidiously. It is all-important, therefore, that medical men and women should band themselves together for the common protection of themselves and the profession to which they belong, and to this end join the British Medical Association. For the objects of this body are to promote the progress of medical science and the interests of the medical profession, and its past history shows that it has well fulfilled them.—*The British Medical Journal.*

SCIENTIFIC BOOKS

The Wings of Insects. By J. H. COMSTOCK. Ithaca, N. Y., The Comstock Publication Company. Pp. xviii + 423, 9 plates and 427 figs.

In these days of distraction from pure science it is a pleasure to note the appearance of Professor Comstock's book on the wings of insects. The whole book is devoted to an exposition of the uniform terminology of the wing veins of insects, a field of scientific research in which Professor Comstock has long been preeminent. The book is founded upon the now well-known theory that the wing veins of insects can only be homologized by a study of the tracheæ which precede them. The historical phases of this theory are discussed together with the general features and development of the wings of insects. A general chapter that ought to be appreciated is the one on paleontological data. Professor Comstock's conclusion after reviewing the various fossil forms is: "A study of the paleontological data confirms to a remarkable degree the conclusions drawn from the study of the ontogeny of living insects as to the probable primitive type of wing venation."

Following the general chapters are special chapters devoted to the wings of the various orders of insects. In these chapters the author has not only used the results of his original investigations but has also used the results of various workers who have given special attention to the different groups. These two sources of information have been welded into a concrete whole that taken together with the illustrations both of wing tracheation and venation can not help but convince entomologists not only of the desirability of a uniform terminology but also of the firmness of the foundation upon which the Comstock system is based.

Z. P. METCALF

STATE COLLEGE,
WEST RALEIGH, N. C.

THE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

THE fourth number of Volume of the *Proceedings of the National Academy of Sciences* contains the following articles:

Dynamical aspects of photosynthesis: W. J. V. OSTERHOUT and A. R. C. HAAS, Laboratory of Plant Physiology, Harvard University. *Ulva,* which has been kept in the dark begins photosynthesis as soon as it is exposed to sunlight. The rate of photosynthesis steadily increases until a constant speed is attained. This may be explained by assuming that sunlight decomposes a substance whose products catalyze photosynthesis or enter directly into the reaction. Quantitative theories are developed to account for the facts.

Mobilities of ions in air, hydrogen and nitrogen: KIA-LOK YEN, Ryerson Physical Laboratory, University of Chicago. Extensive experiments, the rusults of which are in perfect accord with the "small-ion" hypothesis, as contrasted with the "cluster" hypothesis.

Thermo-electric action with dual conduction of electricity: EDWIN H. HALL, Jefferson Physical Laboratory, Harvard University. A continuation of previous papers. The hypothesis of progressive motion by the "free" electrons only has been extended to the case of dual electric conduction.

Terrestrial temperature and atmospheric absorption: C. G. ABBOT, Astrophysical Observatory, Smithsonian Institution. The earth's surface sends out 0.50 calorie per cm^2 per minute on the average, and of this only a small part escapes to space. Hence, the atmosphere is the main radiating source, furnishing three fourths of the output of radiation of the earth as a planet.

Mobilities of ions in vapors: KIA-LOK YEN, Ryerson Physical Laboratory, University of Chicago. A continuation of the study of the vapors SO_2, C_2H_6O, C_2H_4O, C_5H_{12}, etc., with the conclusion that the small ion theory is further corroborated.

A contribution to the petrography of the South Sea Islands: J. P. IDDINGS and E. W. MORLEY, Brinklow, Md., and West Hartford, Conn. Thirty detailed chemical analyses of lava from the South Pacific Islands are given, with a discussion of the results.

The law controlling the quantity and rate of regeneration: JACQUES LOEB, Rockefeller Institute for Medical Research, New York. The quantity of regeneration in an isolated piece of an organism is under equal conditions determined by the mass of material necessary for growth circulating in the sap (or blood) of the piece. The mystifying phenomenon of an isolated piece restoring its lost organs thus turns out to be the result of two plain chemical factors, the law of mass action and the production and giving off of inhibitory substances in the growing regions of the organism.

National Research Council: Minutes of the first meeting of the Executive Board of War Organization; Research Information Committee.

THE fifth number of Volume 4 contains the following articles:

Some spectral characteristics of cepheid variables: W. S. ADAMS and A. H. JOY, Mt. Wilson Solar Observatory, Carnegie Institute of Washington. The hydrogen lines are abnormally strong in Cepheid spectra, which are classified first on a basis of the hydrogen lines, and, second, on the more general features of the spectra.

Types of achromatic fringes: CARL BARUS, Department of Physics, Brown University.

Interference of pencils which constitute the remote divergences from a slit: CARL BARUS, Department of Physics, Brown University.

A study of the motions of forty-eight double stars: ERIC DOOLITTLE, Flower Observatory, University of Pennsylvania. A classification of the stars is set up for the purpose of determining those pairs upon which observations are most urgently needed.

The structure of an electromagnetic field: H. BATEMAN, Throop College of Technology, Pasadena. All electrical charges are supposed to travel along rectilinear paths with the velocity of light. When electricity appears to move with a smaller velocity, it is made up of different entities at different times.

Invariants which are functions of parameters of the transformation: OLIVER E. GLENN, Department of Mathematics, University of Pennsylvania. A general discussion of a systematic theory and interpretation of invariantive functions which contain the parameters of the linear transformations which leaves invariant a binary quadratic form, including the invariants of relativity.

THE sixth number of Volume 4 contains the following articles:

Effects of a prolonged reduction in diet on twenty-five men: I. Influence on basal metabolism and nitrogen excretion: FRANCIS G. BENEDICT and PAUL ROTH, Nutrition Laboratory, Carnegie Institution of Washington, Boston. *II., Bearing on neuro-muscular processes and mental condition:* WALTER R. MILES, Nutrition Laboratory, Carnegie Institution of Washington, Boston. *III., Influence on efficiency during muscular work:* H. MONMOUTH SMITH, Nutrition Laboratory, Carnegie Institution of Washington, Boston.

Possible action of the sex-determining mechanism: C. E. MCCLUNG, Zoological Laboratories, University of Pennsylvania.

The study of the sediments as an aid to the earth historian: ELIOT BLACKWELDER, Department of geology, University of Illinois.

The growth of the Alaskan fur seal herd between 1912 and 1917: G. H. PARKER, United States Seal Investigation, 1914. Since 1912 the steady increase in the numbers of pups born, and of harem bulls and the decrease since 1913 of the average harem are most favorable signs in the growth of the herd. The one unfavorable feature during this period is the considerable increase in idle bulls in 1915, 1916 and especially in 1917. This in-

crease, which can be eventually checked, shows that active commercial killing should have been restored some years ago.

The destruction of tetanus antitoxin by chemical agents: W. N. Berg and R. A. Kelser, Pathological Division, Bureau of Animal Industry, Washington. The results indicate that tetanus antitoxin a substance of non-protein nature, but the stability of the antitoxin is so dependent upon that of the protein to which it is attached, that whenever the protein molecule is split, the antitoxin splits with it.

Tests for fluorine and tin in meteorites with notes on maskelynite and the effect of dry heat on meteoric stones: George P. Merrill, Department of Geology, United States National Museum, Washington.

Notes on isotopic lead: Frank Wigglesworth Clarke, United States Geological Survey, Washington. Investigations on the atomic weight of various forms of lead, and radioactive estimates of the age of minerals, are analysed for the purpose of throwing light upon isotopes and the structure of chemical elements.

The seventh number of Volume 4 contains the following articles:

On the representation of a number as the sum of any number of squares, and in particular of five or seven: G. H. Hardy, Trinity College, Cambridge, England.

The crystal structure of ice: Ancel St. John, Department of Physics, Lake Forest College. Ice is properly assigned to the hexagonal system, and consists of four interpenetrating triangular lattices, of which the fundamental spacings have been obtained.

Fringing reefs of the Philippine Islands: W. M. Davis, Department of Geology and Geography, Harvard University. An interpretation of recently published large-scale charts of the United States Coast and Geodetic Survey.

Dilation of the great arteries distal to partially occluding bands: William S. Halstead, Medical School, Johns Hopkins University. The relative amount of constriction required to give the most pronounced results has been determined, so that the author is able, in almost every instance, to produce the dilation, and a large amount of material thereby accumulated is analyzed.

On the correction of optical surfaces: A. A. Michelson, Ryerson Physical Laboratory, University of Chicago.

Edwin Bidwell Wilson

Mass. Institute of Technology,
Cambridge, Mass.

SPECIAL ARTICLES

INVESTIGATIONS ON THE IMBIBITION OF WATER BY GELATINE

Many investigators in both botany and zoology have recently been at work on the absorption of water by gelatine and other colloidal jellies and from their results have drawn some extremely interesting conclusions regarding physiological behavior. However as the published results accumulate many apparent discrepancies in actual experimental results are appearing. In an attempt to investigate some phases of imbibition by gelatine, I found difficulty in making my conclusions agree with those of previous workers and even in duplicating my own results. In the course of this work certain phenomena of the behavior of gelatine itself came to light and I am offering the following account of some of the preliminary work which I found necessary, in the hope that it may save other workers needless trouble and perhaps help to clear up some of the discrepancies referred to.

Various authors have emphasized the necessity for using material of a constant chemical composition, and for conducting all comparable tests at the same temperature, but the importance of an identical history of water-content and of water-loss seems to have been overlooked.

As was to be expected, the water-content of the gelatine at the beginning of the absorption, strongly influences the rate of water uptake. However, even when different lots of gelatine have the same water-content at the beginning of the absorption, their ability to

absorb water still depends upon their respective water-contents when they were made up, as Table I. shows. Several lots were made up to the concentrations given in the heading of the table, poured out on glass slabs, and allowed to lose water by evaporation at room temperature until tests showed that all had attained the same water-content (one gram gelatine to 0.17 grams water). Then pieces of the same size and form were placed in distilled water and their increase in thickness measured at intervals. The table shows that the lot which had the highest original percentage of water, increased in size most rapidly. That this meant a real difference in the amount of water absorbed was shown by the tests of the water-content at several stages. After 136 hours the pieces which were originally made up to contain 11 per cent. gelatine, had a water content of 98.4 grams per gram of gelatine. At the close of 160 hours the original 20 per cent. gelatine contained 178.0 grams of water per gram of gelatine, and the 33 per cent. gelatine, 100.0 grams of water per gram of gelatine.

The above results indicate that the evaporation of water from the gelatine influences any subsequent absorbing rate. The evaporational history of the gelatine used affects also the distribution of the increase in size among the several dimensions of any given piece, as is shown by the following conclusions which have been drawn from a large number of experiments. The tables to which reference is made contain fair samples of the many readings taken. The tests were made upon gelatine of several concentrations varying from 10 per cent. to 33 per cent. The pieces referred to were rectangular blocks $2.00 \times 0.35 \times 0.35$ cm.

1. When no appreciable amount of water has evaporated from the gelatine since it has set, blocks swell equally in length, thickness and breadth. This is true whether five minutes or forty-eight hours has elapsed since the setting. See Table II.

2. These blocks, when placed on a glass plate with their largest faces in a horizontal position, and allowed to lose water by evaporation at 18° to 30° C., shrink about twice as much in the two short dimensions as in the long one, shrinking being calculated as percentage of original size. See Table II.

3. When the blocks which had received the treatment mentioned in paragraph 2 above, were placed in water and allowed to swell the distribution of amount of increase among the three dimensions was in the same ratio that the shrinking had been. That is, the increase in size was about twice as great for the two short dimensions as for the long one. This distribution of increase continued for at least 60 hours after the gelatine had attained its original water-content. See Table II.

4. When blocks were cut from freshly made gelatine and hung on a thread with the long axes in a vertical position, where they were exposed to the air on all sides, the same distribution of decrease in size among the several dimensions took place as was described under paragraphs 2 and 3 above. The subsequent increase in size when blocks were placed in water also showed the same relation as formerly. That is, the shrinking and subsequent swelling were about twice as great in the two short dimensions as in the long one.

5. When gelatine was poured into a large dish or on to a glass slab and allowed to lose water by evaporation before pieces were cut, the decrease in thickness far exceeded the decrease in the other directions and the subsequent swelling in water followed the same proportions. For example, 15 per cent. gelatine when treated in this manner showed swelling to the following amounts: Height, 181 per cent., breadth 15 per cent., length 6 per cent. For the behavior of 33 per cent. gelatine see Table III. The more water lost by evaporation, the greater the difference in the swelling of the heighth and the other dimensions.

The above results indicate that the evaporation of water from the surface of gelatine jelly changes in some way the physical structure of the jelly. There has appeared thus far no evidence to determine whether these changes concern small group of molecules or much larger masses of gelatine. It may be merely that evaporation taking place more

rapidly in one direction than another causes an accumulation of a greater amount of gelatine in the planes perpendicular to that direction and hence more water can be absorbed and greater swelling take place. That this physical change was brought about by the evaporation of water and not by any natural change in the gelatine itself, was shown by comparative tests on the absorbing capacity of gelatine which was allowed to stand for twenty-four hours, with the absorbing capacity of gelatine which was exposed to the air for the same length of time. The first showed an equal swelling in all directions and the second the greatest swelling along the vertical axis (*i. e.*, the direction of greatest evaporation). It seemed at first that gravity might be a strong force in determining the direction of greatest deposition and hence of greatest swelling, but the experiments reported upon in paragraph 4 above show that it is the amount of surface exposed to evaporation that determines the direction of greatest shrinkage. Therefore, the vertical axis usually shows the greatest shrinkage or swelling because of the custom of pouring gelatine into dishes open only at the top, or onto slabs where the largest evaporating surface is on top. A further in-

TABLE I

Increase per cm. of original thickness of pieces of gelatine which were made up as follows: lot 1, 10 per cent. gelatine, *i. e.*, 1 gram of gelatine to 9 grams of water; lot 2, 13 per cent. gelatine; lot 3, 20 per cent. gelatine; lot 4, 33 per cent. gelatine. All lots were allowed to attain the same water-content by exposure to air at 18–30° C. They were then placed simultaneously into distilled water. The time column indicates the total times of immersion. Each number is an average of measurements taken on six pieces.

Time	Lot 1	Lot 2	Lot 3	Lot 4
16 hours	7.80	7.60	5.30	4.90
40 hours	9.30	9.30	6.50	5.20
64 hours	9.60	11.00	6.95	6.10
88 hours	11.00	—	7.30	6.80
112 hours	12.00	—	9.90	7.90
136 hours	13.20	—	10.50	8.60
160 hours	[1]	—	11.60	10.25

TABLE II

Change per cm. in size of rectangular blocks of gelatine (length = 2.00, height = 0.35, breadth = 0.35). (A) Blocks which have been tightly covered since time of setting, placed in distilled water. (B) Same blocks dried with filter paper and allowed to lose water by evaporation. (C) Same blocks again allowed to absorb water. Ratios are given in brackets below numbers.

Time	No. 1			No. 2			No. 3[2]			Notes
	Length	Height	Breadth	Length	Height	Breadth	Length	Height	Breadth	
24 hrs.	0.32 (1.0)	0.33 (1.0)	0.33 (1.0)	0.36 (1.0)	0.39 (1.1)	0.30 (0.8)	0.40 (1.0)	0.42 (1.0)	0.40 (1.0)	Increase. See (A) above.
3 hrs.	0.27 (1.0)	0.56 (2.1)	0.53 (2.0)	0.21 (1.0)	0.42 (2.0)	0.46 (2.2)	0.22 (1.0)	0.34 (1.5)	0.60 (2.7)	Decrease. See (B) above.
15 hrs.	0.25 (1.0)	0.47 (1.9)	0.53 (2.1)	0.26 (1.0)	0.55 (2.1)	0.52 (2.0)	0.24 (1.0)	0.38 (1.4)	0.58 (2.4)	Increase. See (C) above.
37 hrs.	0.31 (1.0)	0.61 (2.0)	0.66 (2.1)	0.32 (1.0)	0.55 (1.7)	0.66 (2.0)	0.27 (1.0)	0.43 (1.6)	0.49 (1.8)	Increase. See (C) above.
63 hrs.	0.35 (1.0)	0.63 (1.8)	0.74 (2.1)	0.36 (1.0)	0.53 (1.5)	0.67 (1.9)	0.31 (1.0)	0.47 (1.5)	0.45 (1.5)	Increase. See (C) above.

[1] Too soft for measurement.

[2] In the entire experiment 27 blocks were used. Nos. 1 and 2 represent the behavior of 26 of them. No. 3 is given for two reasons: (1) to show that although the shrinking was somewhat differently distributed among the three dimensions, still the relation between shrinking and subsequent swelling remains; (2) to give an idea of the variations which may be encountered when this method of measurement is used. Reference to the last will be made in a later paragraph.

vestigation into this matter might lead to a better insight into the mechanism of the swelling of gelatine. Whatever the mechanism of the change, it remains that always the greatest shrinkage subsequent swelling take place in axis perpendicular to the largest evaporating surface, regardless of the position of that surface.

In all experimentation on the absorbing capacity of gelatine it is, then, necessary to see that the following conditions prevail: (1) all the gelatine has the same original chemical composition; (2) the entire history of water-content from the time of setting to a jelly to the beginning of absorption must be the same for all the material; (3) if water loss by evaporation is to take place before absorption, then pieces or slabs of the same size and form must be used during the process; (4) if the increase is determined by the measurement of length of one dimension, then all measurements must be made on similar axes; (5) all the gelatine must have been exposed to the same temperature conditions.

TABLE III

Increase per cm. of three dimensions of rectangular blocks of gelatine (length = 0.69 cm., height = 0.15 cm., breadth = 0.30 cm.). Solution was made up to contain 33 per cent. of gelatine, poured onto a glass plate, allowed to lose water until nearly hard, cut into blocks and then allowed to absorb water. Ratios are given in brackets below percentages. Numbers refer to averages of two pieces each.

Total Time	3 Hrs.	127 Hrs.	151 Hrs.	175 Hrs.	202 Hrs.
Length..	0.36	0.60	0.65	0.91	1.13
	(1.0)	(1.0)	(1.0)	(1.0)	(1.0)
Height..	1.03	1.39	1.60	1.96	1.96
	(2.9)	(2.3)	(2.7)	(2.2)	(1.7)
Breadth.	0.30	0.42	0.69	0.88	0.88
	(0.8)	(0.7)	(1.1)	(1.0)	(0.8)

Edith Bellamy Shreve
Desert Laboratory,
Tucson, Ariz.

REASON FOR THE HELPFUL EFFECT OF ALCOHOLIC BEVERAGES IN DIABETES, STATES OF DEPRESSION, AND CONVALESCENCE

In diabetes the oxidative processes are defective, as is indicated by the fact that when sugar is ingested, it is not oxidized, as is normally done, but is excreted. This defective oxidation results in the accumulation of certain incompletely oxidized substances, acid in nature, thus giving rise to a condition of acidosis which is thought by many to be the cause of coma in the later stages of the disease. Neubauer,[1] Benedict and Török,[2] Allen and DuBois have shown that the administration of alcohol and alcoholic beverages, such as wine and whiskey, facilitates the oxidative processes in diabetes, thereby enabling the diabetic to burn sugar better with resulting decrease in acidosis and sugar excretion.

The present investigation was carried out in an attempt to determine how alcohol favors or facilitates oxidation in diabetes. It is known that oxidation in the body is increased by exercise or work, by the ingestion of food, by thyroid feeding, during the excitement stage of anesthesia, and in combat, and that oxidation is decreased by decreasing the amount of work or the amount of food ingested, during deep anesthesia and in phosphorus and chloroform poisoning. We found that when oxidation was increased in the ways enumerated, there occurred a corresponding increase in catalase, an enzyme in the tissues and possessing the property of liberating oxygen from hydrogen peroxide, due to the stimulation of the liver to an increased output of this enzyme into the blood, and that when oxidation was decreased, there occurred a corresponding decrease in catalase in the blood and tissues due to the decreased output of this enzyme from the liver and utilization in the tissues. From these results it was concluded that catalase is the enzyme in the tissues principally responsible for oxidation. Furthermore, we[3] showed that the catalase of the

[1] Neubauer, O., *Münchener med. Wochenschrift*, 1906, LIII., 791.

[2] Benedict and Török, *Zeitschrift für klinische Medizin*, 1906, LX., 329.

[3] Burge, *American Journal of Physiology*, 1916, XLI., 153; 1917; XLIII., 57, 545, 1917; XLIV., 290; Science, N. S., 1917, XLVI., 440. Burge, Kennedy and Neill, *American Journal of Physiology*, 1917, XLIII., 433. Kennedy and Burge, *Arch. Int. Med.*, 1917, XX., 892.

tissues was greatly decreased in pancreatic diabetes and accordingly suggested that the defective oxidation in this type of diabetes was due to the decrease in catalase. If the defective oxidation in diabetes is due to the decrease in the catalase of the tissues and if it can be shown that the administration of alcohol produces an increase in the catalase of the tissues due to the stimulation of the liver to an increased output of this enzyme into the blood, then it would seem probable that the helpful effect of alcohol in diabetes is due to the increase in catalase with resulting increase in oxidation.

Dogs were used in the investigation. The catalase in 0.5 c.c. of the blood of the animals was determined by adding this amount of blood to 50 c.c. of hydrogen peroxide in a bottle at 22° C. and as the oxygen gas was liberated, it was conducted through a rubber tube to an inverted burette previously filled with water. After the volume of gas thus collected in ten minutes had been reduced to standard atmospheric pressure, the resulting volume was taken as a measure of the amount of catalase in the 0.5 c.c. of blood. The material was shaken at a fixed rate of one hundred and eighty double shakes per minute during the determinations.

Twenty-five c.c. per kilo of body weight of 45 per cent. ethyl alcohol were introduced into the stomachs of the animals by means of a stomach tube. Previous to as well as at 15-minute intervals after the introduction of alcohol, the catalase in 0.5 c.c. of blood taken from the external jugular was determined. Fifteen minutes after the introduction of alcohol into the stomach, it was found that the catalase of the blood was increased by about 30 per cent., after 30 minutes by about 50 per cent., and after 45 minutes the catalase of the blood of some of the dogs was increased by as much as 100 per cent.

After etherizing other dogs the abdominal wall was opened and the catalase of the blood taken directly from the liver or from one of the hepatic veins as well as from the jugular was determined. It was found that the blood from the liver was richer in catalase by ten to fifteen per cent. than the blood from any other part of the body. This was taken to mean that there is a continuous output of catalase from the liver into the blood and that this catalase is taken to the tissues to be used presumably in the oxidative processes. After the introduction of the alcohol into the stomach of the animal, it was found that the catalase in the blood taken directly from the liver was increased much more rapidly than that taken from a systemic vein such as the jugular, hence the alcohol must have been stimulating the liver to an increased output of catalase and in this manner producing an increase in the catalase of the blood and hence of the tissues.

Alcohol was also administered to dogs rendered diabetic by the removal of the pancreas, and it was found that the catalase of the blood and hence of the tissues of these animals was increased. It is probable that the helpful effect of alcohol in states of depression and in convalescence as well as the exhilarating effect on normal subjects is due to the stimulation of the liver to an increased output of catalase with resulting increase in oxidation.

The conclusion is drawn that the administration of alcohol to diabetics is helpful because it stimulates the liver to an increased output of catalase which is carried by the blood to the tissues where it facilitates the oxidative processes with resulting increased oxidation of sugar and decreased acidosis.

W. E. Burge

Physiological Laboratory of the
University of Illinois

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, OCTOBER 4, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

ECONOMIC TOXICOLOGY

CALIFORNIA annually spends more than a million dollars in the control of insects and fungi infesting citrus trees, and possibly a million more for a like purpose on deciduous trees. To these startling figures may be added no small amount expended in the control of the pests of garden and field crops, stored grain and seeds, and a large sum in the preservation of timber against the attack of wood-destroying fungi. The vineyards need protection from the ravages of mildew. Nor does this conclude the list. There must be added a considerable sum for the control of the parasites of man and beast. Tons of poisoned barley and quantities of expensive chemicals are used to rid the fields of vertebrate pests. The customary way of holding in check this formidable array of pests is by the use of chemicals of various sorts. Of recent years, chemicals have also come to be used to some extent for the control of weeds, and no little interest is being taken at the present time in possible developments in this connection under California conditions. It is said that California is the largest consumer of insecticides and fungicides of any state in the union. The state at least makes use of the greatest variety of these and other economic poisons on account of the great diversity of its agriculture.

These facts, from an economic standpoint alone, justify not only an intensive study of the proper use of the materials, but also a comprehensive study of the materials themselves. This station early recognized the need of the special knowledge of the chemist in the solution of the vexing problems that often confront the investigator who has to deal with the control of pests. Through the publication of Morse in 1887, the utility of hydrocyanic acid as a fumigant for the control of scale insects on citrus trees was first made public,

Under the direction of Professor Woodworth, the activity of the Division of Entomolgy in the investigation of insecticides dates back many years. The early publications of the insecticide laboratory by Woodworth and Colby were among the first to call attention to the need of legislation to protect the consumer against the unscrupulous or careless manufacturer of insecticides. The development by Volck and Luther of a new type of lead arsenate which could be used with safety in the humid coast regions is to the credit of the Division. The later studies by the head of the Division on the complex problems arising in the practical application of fumigation methods are probably the most exhaustive of any similar effort made elsewhere.

The scope of the activities of the insecticide laboratory was enlarged in 1911 to include a study of fungicides. The state insecticide and fungicide law came into operation that year and the chemical work incidental to its administration was assigned to the laboratory. The administration of the law was placed in the hands of the director of this station, although the immediate supervision of the work was assigned to the head of the division of Entomology. The writer became identified with the work at this time.

The most pressing need for chemical study appeared to be the origination and perfection of methods of examination of insecticides and fungicides which were on the market in endless variety and were of such complex composition as to defy ordinary analytical procedure. An intelligent study of analytical methods presupposed some slight knowledge at least of the nature and source of the raw materials and of manufacturing methods in order to know what impurities to look for and to fairly judge their permissible limits in commercial samples.

The reorganized laboratory began work along the lines indicated above, but it soon became evident that it could be of more use to the state than to merely inform the public of the composition of the materials which came to its notice. The greater need seemed to be a more complete knowledge of the toxicology of the materials; a better knowledge of which constituents of the various preparations are active and which inert; the constituents injurious to foliage, and to what extent; the most suitable remedies to choose in order to meet the varied and exacting requirements for the control of pests; and which materials could be mixed with safety and applied in combination.

As opportunity was afforded, the solution of some of these problems was also attacked. It soon became evident that the accumulation of laboratory data alone was wholly inadequate for the solution of many of the problems encountered. A definite effort was made to interpret the results of the laboratory by means of field observations whenever possible.

As a result of these studies, the laboratory has made contributions to agricultural literature from time to time. In this manner and through correspondence and by occasional talks by members of the staff before agricultural audiences, it is felt that the work of the laboratory has been of greater usefulness to both manufacturer and consumer than if the work had been confined more largely to the carrying out of the routine police work of the law.

Another activity of the laboratory has been that of instruction. When the writer first began to collect material suitable for the presentation of a course entitled "Insecticides and Fungicides," it was soon discovered that the great mass of literature on the subject was on the *practical use* of these materials rather than on their composition and properties. Such courses offered at other universities were being given by horticulturists, entomologists, plant pathologists or botanists and the subject was, therefore, discussed from their standpoints. Furthermore, it was found that the students of this college of agriculture were already being well supplied with adequate instruction along these lines by the several divisions. It was clear that it would be inadvisable to offer a course of lectures patterned after the usual lines—largely a reflection of the information already supplied by other courses. There did seem to be a need, however, of a course pre-

sented from the standpoint of the chemist—a discussion of the *composition, properties,* and *toxicology* of the remedies used for the control of agricultural pests. An effort was made to accumulate all available information from this viewpoint; the materials were classified according to active ingredient or derivation rather than according to use as had been heretofore done; and the subject presented accordingly as a three-unit course of lectures.

A one-unit laboratory course was also offered by Mr. Miller, taking up in a practical way the most approved methods of preparation of pest remedies and demonstrating the significance of the simpler tests. The students were divided into groups and each required to prepare the commoner preparations which may be made on the farm, and were given an insight into the underlying principles of commercial manufacturing methods. The use of elaborate apparatus was consistently avoided, only such utensils and measuring devices being used as would be found on the average California ranch. It was thought that if the students were taught the fundamentals of the various processes without any unusual equipment, they would be better able to make use of whatever equipment, simple or elaborate, would be provided them in later years of actual work.

That this sort of instruction filled a want is evidenced by the fact that the enrollment increased from seven the first year to forty the fourth year that the courses were offered.

In the fall of 1915, the laboratory was instructed to undertake an investigation of chemical means for the control of noxious weeds. Sets of experiments have been conducted in five localities, some of which have been under observation for more than two years. These investigations have furnished some very interesting data, both from the practical as well as from the scientific standpoint, the results of which are to be soon published as a progress report.

At first thought, it may seem strange that a study of herbicides was assigned to a chemical laboratory heretofore devoted to the study of insecticides and fungicides. A careful analysis, however, of the toxicological problems encountered in either case discloses a very close correlation of certain phases of the work.

The accumulation, classification, and otherwise making available of an accurate and complete knowledge of the source, manufacture, composition, and properties of the poisons used for the control of insects, fungi, weeds and other pests is work for which the chemist has been trained. When any of these poisons are to be used upon vegetation for the control of insects or fungi, it is fully as important to know their action on plant tissues as their action on the pest, in order to avoid the use of any remedy which may seriously injure the plant. Certain of these poisons can be used at certain times of the year only, or upon certain plants only; others are suitable for use under restricted climatic conditions. Some of these facts are directly applicable to the problem of weed control by means of chemicals. The materials to avoid in the first case may be just the ones to use in the latter case. These observations may be well illustrated by referring to some of the results of this laboratory's herbicide investigations. It is a well-known fact that soluble arsenic (except in very small amounts) is not permissible in any spray which is to be applied to cultivated plants on account of the danger of foliage injury; a completely soluble compound of arsenic was found to be the most effective of any chemical tried for the destruction of weeds. Unpublished experiments by Mr. E. R. de Ong and the writer, testing the action of petroleum oils on foliage, indicated that the constituents of petroleum distillates which are capable of removal by refining with sulfuric acid are very much more toxic to foliage than other constituents; a by-product of oil refineries, containing these highly toxic constituents, was found to be a very effective herbicide.

Quite recently this laboratory has been called upon to analyze a number of squirrel, gopher and rat poisons and to pass on their respective merits, and to answer letters on this subject which were referred from other departments.

It is thus seen that the scope of activities

of the laboratory has steadily (perhaps unconsciously at times) enlarged from a most creditable beginning in the study of insecticides, so that its work included the study of fungicides, then herbicides, and lastly, poisons for the destruction of vertebrate pests. Shall we call the latter "rodenticides" or "zooicides" in order to complete the nomenclature of the list?

The question may be asked: Should not insecticides be studied by the economic entomologist, fungicides by the plant pathologist, herbicides by the economic botanist, and rodent poisons by the economic zoologist? Most certainly they should be. In fact, they have been, and, as a result, the most important contributions to the literature have come from these sources. The questions involved are so complex as to require the application of the special knowledge of all of these scientists. The specially trained chemist may also contribute his share toward the solution of their common problems, a more intimate knowledge of the poisons which may be to a certain degree lacking in the others.

In an organization as large as our experiment station, it is sometimes difficult to avoid duplication of work by the various divisions. One way of avoiding duplication is for each man or group of men to have a very clear and well-defined conception of their respective functions in the machinery of the organization, whether it be a cog, a crank, a governor, or a safety valve, and then to confine their activity to the efficient performance of these functions. A study has been made of what should be the functions of this laboratory and it appears that it will serve the state well if it acquires and disseminates as complete a knowledge as possible of the poisons which are used for the control of insects, fungi, weeds and rodents; insecticides, fungicides, herbicides and "rodenticides."

It has often seemed desirable to make use of a collective term in referring to the materials which are under study by the laboratory. Various names have been suggested, the most appropriate of which appears to be "economic poisons."[1] The qualifying word "economic" serves to distinguish between the poisons which are made to serve a useful purpose in the control of pests and the more popular conception of the meaning of "poisons" as being substances harmful to man. The use of the former is strictly of an economic character and anticipates either direct financial returns, or an improvement of the general welfare of the public. The expenditure of a dollar in the control of crop-destroying pests is not usually justified unless more than a dollar is thereby added to the net returns from the harvest. On the other hand, the poisoning of mosquitoes, flies, rodents, etc., in the interest of public health, does not necessarily involve the question of direct financial return. From both standpoints, the term "economic poisons" seems appropriate as referring to the materials under discussion.

The work of the laboratory has been thus described as having developed into a study of the various poisons, beneficial use of which has been made by society. Toxicology is the science which treats of poisons, their effects, antidotes and recognition. This science, however, has been developed largely among men of the medical profession and deals with the poisons in respect to their harmfulness to man and their use with criminal intent. As undertaken by this laboratory, poisons are studied for an altogether different purpose. Clearly, then, the unqualified word "toxicology" can not be used in this connection without confusion. Inasmuch as the study of poisons in respect to their harmful use has been given the name "toxicology" the term "economic toxicology" will serve to differentiate the study of poisons in relation to the control of pests detrimental to agriculture and to the public health, and may be used to describe the activities of this laboratory.

Geo. P. Gray

Insecticide and Fungicide Laboratory,
Agricultural Experiment Station,
University of California

[1] The terms "economic poisons" and "economic toxicology" were suggested by the writer's associate, Mr. M. B. Miller. See this journal, Vol. XLIV., No. 1135, page 264.

ORGANIC SYMBOLS

The idea to assign an individual symbol to each organic compound, of which over 110,000 are known, seems absurd, impractical and too complicated for a student to master. It would even put the Chinese characters in the background as far as the number of symbols is concerned. Nevertheless a system of organic symbols is not only possible and practical, but also simple and efficient and offers a time- and space-saving device for modern chemistry. In a recent paper[1] such a system of symbols was outlined and some of its advantages have been pointed out. Each symbol represents the structure of the organic compound and indicates furthermore the optical activity, isomeric form and chemical type of a definite organic compound.

The system of symbols is based upon the four elements, hydrogen, oxygen, nitrogen and carbon, while all the other elements entering into a compound are represented by their ordinary chemical symbols. The atoms of these four elements are thought to be points in the symbols, these points to be determined by lines terminating (H), meeting (O and N) or crossing (C). Accordingly hydrogen is a point from which one line radiates, oxygen a point from which two lines radiate, nitrogen three and carbon four lines, radiating respectively. The lines are therefore the bonds or valencies of the respective elements and we have:

Hydrogen Oxygen Nitrogen Carbon

Thus a hydrogen atom is assumed to exist wherever a line ends. Oxygen is supposed to stand wherever a line makes an angle or two lines come together. Nitrogen exists at the point where three lines meet or arise, and carbon is thought to be at a point where two lines cross or four lines radiate. The length of the lines is immaterial. They are straight when representing single bonds and curved when representing double bonds.

With these simple principles all organic structure-formulas can be accurately and exactly reproduced and the resulting geometrical figures or "organic symbols" offer certain advantages worthy of notice:

1. Compactness, for the structure has been brought to a very narrow compass, enabling the extensive use of the symbols where space is limited, *e. g.*, in abstracts and catalogs.

2. Exactness, for each symbol represents only *one* definite organic compound of a definite structure and isomeric form.

3. Accuracy, for it is impossible to write for a given compound a structure symbol which is *not* theoretically correct, provided the simple rule regarding H, O, N and C is followed.

4. Clearness, for the design of the symbols of certain types of compounds is distinct and helps the student to remember the characteristic structure of a group of compounds or a radical like —COOH, etc.

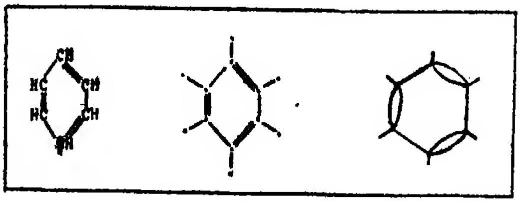


Fig. 1. The Organic Symbol for Benzene.

5. Simplicity, for with a very few rules thousands of compounds can be constructed and readily understood.

In Fig. 1 the comparatively simple transformation of the structural formula of benzene to its organic symbol is schematically represented, while Fig. 2 shows a comparison

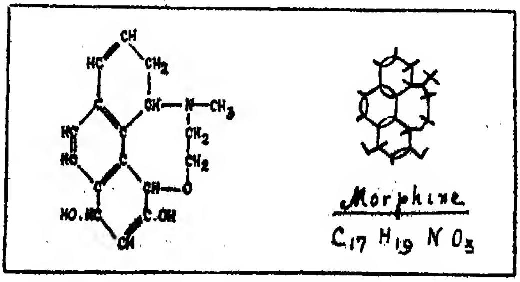


Fig. 2. The Organic Symbol for Morphine.

[1] *Canadian Chemical Journal*, Vol. 2, p. 135, May, 1918.

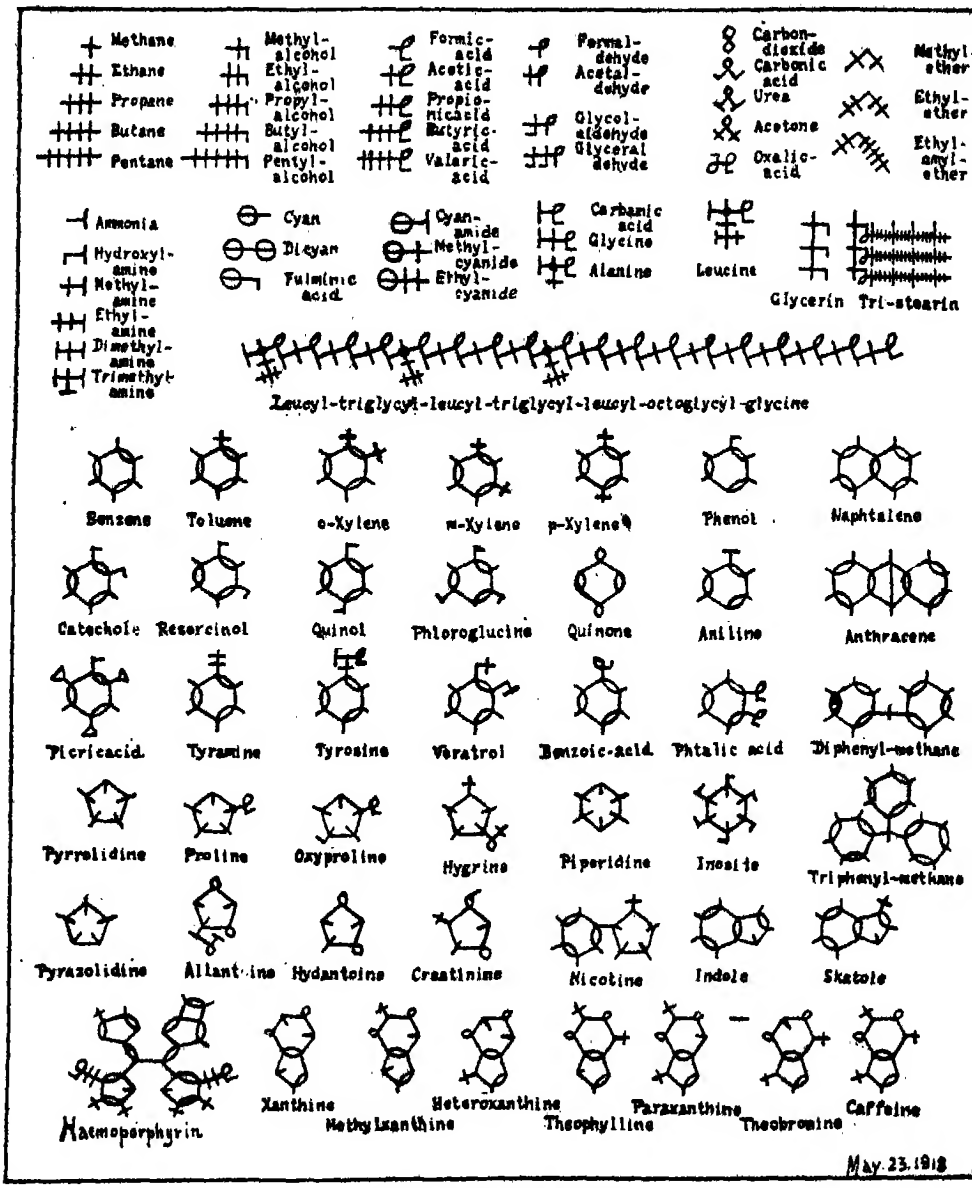


FIG. 3. Organic Symbols.

of the structural formula of morphine and its organic symbol. It will be noticed that as a whole the symbols differ not much from the structural formula as far as their geometrical form is concerned, but are naturally more precise. That is to say for example the symbol of acetic acid

does not only mean $CH_3.COOH$, but actually

$$\begin{array}{l} \;\;\mathrm{H} \\ \;\;\cdot \\ \mathrm{H}\cdot\mathrm{C}\text{—}\mathrm{C}{:}\mathrm{O} \\ \;\;\cdot\quad\;\cdot \\ \;\;\mathrm{H}\;\;\;\mathrm{O}\cdot\mathrm{H} \end{array}$$

and is therefore much more exact by recording not radicals but each atom separately.

In Fig. 3 is a list of some typical symbols for different classes of compounds. A dot (*e. g.*, in leucine) indicates an asymmetric carbon-atom and thus the optical active compounds are characterized. The long decorative design represents an octodeca-peptide or artificial peptone. Of the ring compounds mainly simple representatives have been selected, but some of the purin-bases at the bottom of the table (xanthin and derivates) show the simplicity of complex-rings. It will be noted that the different derivates are very plainly shown in their relationship, differing in that case only by the addition of one, two or three $—CH_3$ groups (crosses in the symbols). Hæmoporphyrin, the mother substance of hæmatin of the hemoglobin of the blood, is an example of the more complex structures which recent investigations have disclosed.

With the rapid progress in organic chemistry and the structures of compounds becoming more and more complex, the need for a simple device of recording facts becomes apparent and I am indebted to the late Dr. Henry S. Denison, whose suggestions[2] on a "chemical shorthand" caused the working out of the present system of "organic symbols." While the system is still in the precarious state of development, it is necessary to warn against indiscriminate use of the principles involved in constructing symbols. An indiscriminate application would lead to confusion and for this reason certain standard types of symbols must be established. These standard types must or should conform as far as possible to the theories concerning the arrangement of the atoms in the molecules. A ring of six atoms would be represented by a hexagon, and not by a square, one of five atoms as a pentagon and so on (compare, *e. g.*, xanthin).

In certain cases nitrogen possesses a valency of five and in Fig. 4 the relationship of these symbols is shown. Also the use of the ordinary symbols in connection with organic symbols. S = sulfur in thiophen, Cl = chlorine in chloroform.

The writer has already employed the system in one of his classes with success and found it a time- and space-saving medium in transmitting facts of organic chemistry to students and hopes that the system may become of value to other scientists.

INGO W. D. HACKH

BERKELEY, CALIF.

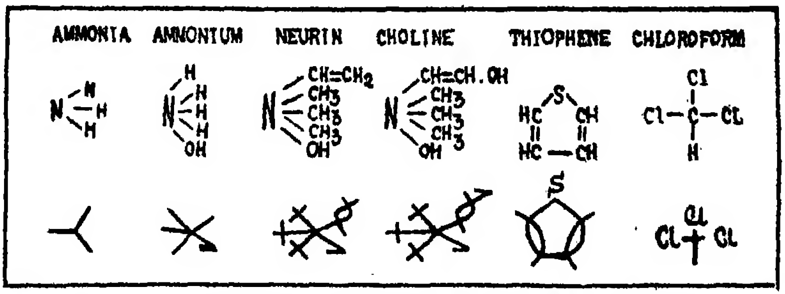


FIG. 4. Pentavalent Nitrogen and Examples of other Elements.

[2] *Denver Medical Times*, Vol. 31, p. 360, 1912.

FRANK N. MEYER[1]

MEYER was in the second year of his third great Middle Asiatic Exploration. His first trip of two years covered North China, including Mantchuria, in which province he walked 1,800 miles. His second trip of three years included the Caucasus, Persia, Turkestan, eastern Thibet, the middle districts of the great empire and Japan. His third trip was to have covered all the more southern portions of China likely to contain plants useful to western agriculture. During these seven years which were full of strange adventures he made thousands of interesting observations, penned

[1] Drowned in the Yang-tsze-kiang, June 1, 1918, and buried in Shang-hai, China.

copious records, took hundreds of superb photographs and secured a great variety of interesting and useful plants, many of which are now growing in the United States. Previous to these trips he had visited all parts of the United States and had walked across central Mexico, sleeping in Indian villages or on the mountain sides. Earlier in life he walked from Holland to Italy, guided only by his compass, and nearly lost his life in the Alps, overtaken by a snow storm. The first person he met in Italy said: "Where did you come from?" and then "Impossible! There are no roads!" when he replied "From over the mountains." Before he came to the United States (in 1900) Meyer had been gardener to Hugo de Vries in Amsterdam for eight years. He had also lived and studied in London. Meyer was one of the most friendly men I have ever known and one of the most interesting. He was also a just and upright man. His knowledge of plants was phenomenal and especially of conditions suited to their growth, but he was interested in everything pertaining to the countries he visited—climate, topography, fauna, flora, geology, ethnology, art archeology, religion. He was an entertaining public speaker, as many can testify, a good conversationalist and a copious and fascinating letter writter. A published volume of his letters would be as interesting as a novel, more interesting than most novels. He had also a gift for linguistics, being most at home in Dutch, German and English, but knowing also something of French, Spanish, Italian, Russian and Chinese. On the whole, Meyer preferred the United States to any other country and had become a citizen, but the narrowing conventions of our social life irked him a good deal at times—"The sky is too near" was his whimsical way of putting it—and after a few months of Washington life there was always a longing for the free air of the wilderness. Grand mountain scenery in particular appealed to him strongly. Early in life he spent a year in a Dutch social colony, a kind of second "Brooke Farm," founded by the poet Dr. Frederik van Eeden, but the serpent of selfishness was there also, he told me. In philosophy Meyer was a follower of Schopenhauer; in politics a Marxian Socialist; in religion a Buddhist. It is not known how he met his death. He was ill at the time, it is said, and disappeared in the night from a river steamer. He was in middle age, of medium height, stocky, broad-shouldered, strong. He had blue eyes, brown hair, a big beard and regular features.

O brother of all men and faithful friend,
By riddle of the world made desolate,
'Tis meet an Asian flood should be thy fate,
By *Welt-Schmerz*, *Welt-Gang* driv'n to sad life's end!
Nobly to plan is life! Life's worth, its trend;
Mere close of life is naught, or soon or late!
Lonely he lived, alone he died, but great!
His growing fame nor gods nor men forfend!

The splendid good he did shall live and grow
To fructify with Time and bless mankind,
Which was his noble dream and life-long goal!
But who that did not call him friend shall know
The opalescent wealth that stored his mind,
His breadth of view, his tenderness of soul!

Erwin F. Smith

SCIENTIFIC EVENTS

RUSSIAN WHEAT

The *Bulletin* of the Neuchâtel Geographical Society (vol. 26, 1917) contains an elaborate paper by Léon Felde on the "Production and Export of Russian Wheat." According to an abstract in the *Geographical Journal*, the first part (pp. 80) discusses very fully, if not very deeply, the whole question of production—soil, climate, technical and social conditions; the second part does the same for the commerce, dealing with the internal and external transport from all points of view, but specially with exports to Switzerland. It is a very useful compilation, marred only by some rigidity, *e. g.*, the fixing of germination at 6° C. and the accumulated temperatures being stated definitely as 2000°, the relation of higher accumulated temperatures to latitude and higher mean temperatures being thus ignored.

The spring-wheat area falls, typically, within the area of highest general culture. It lies parallel with the rain-bearing winds—north

eastwards from the Sea of Azov, along isotherm 22° C. (*c.* 71° F.) in July, while the winter-wheat area lies athwart the winds, parallel with the Black Sea coast, especially southeast of the Azov, *i. e.*, along isotherm—4° C. in January. The spring-wheat area is, therefore, associated with greater range of temperature (having an average of —10° C. in January), as also with greater variation of yield, this having varied from 58,000,000 cwts. in 1906 to 148,000,000 in 1913; and such variation helps to account for the excessive variation in price, which even at Odessa varies from 29 per cent. below normal to 32 per cent. above, while at Saratov it varies from 35 per cent. below to 62 per cent. above. Both areas have sudden increase of rainfall in May, then maximum in June-July, a dry autumn, and some increase of rain again in November or December. And it is, of course, the "temperate" winters that are bad for the winter wheat (p. 27)—in hard winters it seems to take no harm. In fact, wheat-growing is greatly facilitated by both soil and climate, but there are at present insuperable difficulties against introducing intensive culture, although the wheat area has—for Russia—quite a dense population (25 to 70 per square mile). In the absence of scientific agriculture, the result of this comparative density is that only sixteen governments, out of c. 70 in European Russia, have normally any surplus wheat for export; and this surplus is based on a per capita consumption of 150 pounds in 1913, as against 60 pounds in 1906. Still, cereals make two thirds of the total value of Russian exports, wheat having over one third of the total cereal value. The transport is by both water and rail, the useful "floatage" being estimated at c. 90,000 miles and the navigable water at c. 28,000 (excluding Finland), and an annual duration varying from an average of 263 days (with a range of 50) on the Dnieper, to one of 231 days (with a range of 29) on the Don, and one of 223 (with a range of 67) on the Lower Volga. The statistical returns emphasize in the most marked way the insignificance of Odessa as a wheat port. For some years it has never been in the list of the first six. It is generally far behind its two neighbors of the Dnieper liman, Kherson and Nicolaiev—the latter, as an important railway junction on the only line to Kherson and with a much wider river, having the steadier trade of the two. All three together were not equal to Rostov in 1913, with its 17 per cent. of the total Russian export, while even Riga is usually at least as important as Odessa. The sheltered "Riviera" port of Novorossiskaya, the terminus of the Volga line from Tsaritsin, comes next to Rostov, with c. 9 per cent. of the total export and has a very steady trade; and Taganrog usually stands third, though large quantities of wheat are exported from other Azov ports, *e. g.*, Yessk, Berdiansk, Mariupol and Feodosia—which really counts as an Azov port. Altogether, c. 45 per cent. of Russian wheat exports go from the Azov, the Black Sea proper having only c. 40 per cent.; and the quantity in millions of pounds roughly approaches the value in millions of roubles (203 and 225 in 1913). For years before the war Russia had furnished Switzerland with her chief supplies of wheat, though by 1912 the proportion had fallen slightly below 50 per cent., while it was only 36 per cent. in 1913. The grain moved via Genoa or Marseilles or Mannheim, some going on as far as Strassburg or Kehl; and the manipulation of dues on the German railways was such that, though the water rate to Mannheim was c. 1,400 francs per quintal as against 800 to Genoa or Marseilles, the total cost to Berne was only c. 3,200 francs as against 3,070 via Genoa and 3,300 via Marseilles. The saving to Zurich was 300 francs greater. The extra time for delivery to Switzerland via the Rhine was 20 days.

THE SUPPRESSION OF BODY-VERMIN

A COMPREHENSIVE paper entitled "Combating Lousiness among Soldiers and Civilians," by Professor G. H. L. Nuttall, appears in *Parasitology* for May. According to an abstract in *Nature*, the paper is one of a series which when complete, will constitute an exhaustive monograph on human lice. It brings together, not only the available published

information, but also that resulting from hitherto unpublished research work, partly the author's own, and partly that of others contained in reports to the War Office, which he has been permitted to use. Professor Nuttall has generously presented a special edition of three hundred copies of the paper to the Allied Armies; and, in view of the recently established fact that the trench fever is conveyed by lice, this should prove a very timely gift.

The paper comprises 176 pages, with four plates and twenty-six figures in the text. Most of the pages are devoted to the practical consideration of louse destruction a great deal of the experimental evidence being given in detail. The results obtained demonstrate that nits are killed by dry heat at 65°–70° C. in one minute, and at 55°–61° C. in ten minutes, the active stages being killed by dry heat at 65°–70° C. in one minute and at 55° C. in five minutes. After allowing for a margin of safety in practise, immersion in hot water at 70° C. for a minute or two is amply sufficient to destroy lice, while 55° C. for ten minutes is equally effective, a point of great importance in relation to the washing of flannel garments.

Singeing, sun-baking, and the use of hot flat-irons are briefly dealt with. The various methods devised for disinfection by hot air and steam are treated of at length, and illustrated by text figures of disinfestors improvised for war purposes, together with plates depicting the more elaborate forms of disinfestors designed for use in peace time. We agree with the author that apparatus designed with a view to high efficiency against the resistive spores of bacteria is not adapted for rapid and economical use against lice. It should be replaced by more commodious hot-air and steam huts, or disinfectors planned on the improvised railway vans said to have been so successful in the east. Designs of this type of chamber should also be adapted for steam or motor lorries, as well as trailers, which could, if necessary, be horse-drawn.

Steam gives results superior to hot air if the destruction of pathogenic bacteria is an object, but dry heat possesses many advantages over steam if the destruction of body vermin is the end in view. The use of sulphur is treated of at some length. We endorse the author's remarks as to the failure of sulphur vapor to destroy all the nits exposed to it, while its relatively high cost, the danger of injury to clothing and its slow action are further disabilities of the method.

In the section dealing with insecticides and so-called repellents, the results of the great mass of experimental work are tabulated in detail, an unavoidable course owing to the wide diversity of method employed by the various workers. In these experiments lice and nits were immersed in, brought into contact with, and submitted to the action of the vapor of various substances and preparations.

THE FUR SEALS OF THE PRIBLOF ISLANDS

In the present calendar year to August 10, the end of the regular killing season, 33,881 sealskins were taken at the Pribilof Islands. Of these, 7,000 were taken on St. George Island and 26,881 on St. Paul Island. The Department had authorized a take of 35,000 skins, 7,000 on St. George and 28,000 on St. Paul. Some few seals will be killed from time to time during the remainder of the year for the purpose of furnishing fresh meat for the natives.

By the terms of the North Pacific Sealing Convention of July 7, 1911, 15 per cent. of this year's take of skins belongs to the Canadian government and a like proportion to the Japanese government. There will be no actual delivery of these skins, but, under the provisions of the convention, the market value of the skins will be credited to the respective governments as an offset to certain advance payments made to them by the United States.

A census of fur seals on the Pribilof Islands was conducted by G. Dallas Hanna, and preliminary figures, subject to slight modification when all the data have been carefully examined, have been received. The number of pups born was 143,005, and the number of breeding cows was the same. The approximate total size of the Alaskan herd was 496,-

600. The average harem, based on a count of seven rookeries, was 26.76. The census was of date of August 10, and did not include the 33,881 seals taken during the present calendar year.

Reports have been received from the superintendent and physician, United States Indian Service, Neah Bay, Wash., that he has authenticated 386 fur-seal skins taken this season by Indians dwelling on the coast of Washington. The seals were all speared from canoes and were taken from 10 to 25 miles west of La Push, Wash. The records show that 379 of the skins were taken in April, May and June, 1918, and that 245 of the seals were males and 139 females. The superintendent also stated that a few skins remain untagged, and a report on the number will be made at the close of the season.

The lighthouse tender *Cedar*, which had on board some of the heavier portions of the equipment for the new by-products plant for St. Paul Island arrived at the island on August 11. The material was successfully landed, and ground for the foundation of the plant was broken on the 14th. The balance of the equipment for the plant was delivered by the *Roosevelt* in August. The active sealing operations were over by the 10th, thereby permitting the energies of the station to be devoted largely to the erection of the plant. It is hoped to push the work of constructing the buildings and installing the machinery rapidly to completion and to begin the manufacture of oil and fertilizer from seal carcasses this season. The carcasses of approximately 27,000 seals which have been killed on St. Paul Island this year will furnish ample material for preliminary operations.

RESEARCH GRANTS FROM TRUST FUNDS OF THE NATIONAL ACADEMY OF SCIENCES

DURING the twelve months preceding the annual meeting of the academy the following grants for the promotion of research were made from the trust funds of the academy.

GRANTS FROM THE BACHE FUND

No. 205, T. H. Goodspeed, University of California, $100. For studies of inheritance in *Nicotiana* hybrids.

No. 206, Reginald A. Daly, Harvard University, $700. For the completion of the deep sea thermograph designed and partly constructed under Grant No. 194. In continuation of No. 194.

No. 207, T. H. Gronwall, New York City, $300. To complete and extend mathematical researches on conformal representation.

No. 208, A. Franklin Shull, University of Michigan, $400. To investigate the cause of sex production and the life cycle of rotifers, together with artificial modification of life cycle; differential factors in fertilization of male-producing and female-producing rotifers; sex determination and the life cycle of the thrips; cause of sex production, wing production and other cyclical phenomena in aphids.

No. 209, Cecil K. Drinker, Harvard Medical School, $350. For the closer study of the factors involved in extension of unchecked red cells and leucocytes in the dog.

GRANTS FROM THE WATSON FUND

No. 16, Herbert C. Wilson, Goodsell Observatory, $300. For a continuance of the work of the determination of the position and brightness of asteroids (chiefly those discovered by Watson by the photographic method, together with a study of the brightness of some variable stars. (Supplementary to Grant No. 15.)

No. 17, John A. Miller, Sproul Observatory, $500. To measure plates for determining stellar parallaxes. (Supplementary to Grant No. 14.)

GRANTS FROM THE J. LAWRENCE SMITH FUND

No. 9, S. A. Mitchell, University of Virginia, $300. To continue his researches on the paths, radiants and orbits of meteors. (Supplementary to Grant No. 8.)

GRANT FROM THE MARSH FUND

No. 2, M. Ferdinand Canu, Versailles, France, $250. For investigation in cooperation with Dr. R. S. Bassler, of the United States National Museum, of the early tertiary bryozoa of North America.

SCIENTIFIC NOTES AND NEWS

PROFESSOR ERNEST FOX NICHOLS, of Yale University, has been given further leave of absence to continue his work in the Ordnance Department.

LIEUTENANT COLONEL DR. JOHN M. T. FINNEY, surgeon-in-chief of the American Expeditionary Forces, on his recent visit to the United States laid plans before the President

for the establishment of hospitals for the treatment of shell shock. The necessary funds have been provided and Dr. Finney has returned to France.

A MISSION headed by Colonels Combe and Dr. Lure has been sent to France by the Canadian government for the purpose of studying the measures that have been taken in reconstruction work among the maimed and the invalided.

PROFESSOR HIRAM BINGHAM, of Yale University, who is a lieutenant colonel in the Aviation Section, Signal Corps, of the Regular Army, has been appointed chief of the Personnel Section in the office of the Chief of the Air Service, American Expeditionary Forces.

DR. RALPH G. VAN NAME, of Yale University, has qualified as chemist in the government service.

CHARLES V. BACON was commissioned a captain in the Engineer Reserve Corp on July 2 and is now stationed at the General Engineer Depot, Washington, D. C., in the Division of Investigation Research and Development, being a member of the executive committee. Captain Bacon was formerly associated with the American University Experiment Station as chief of the section on flaming liquids, and later as chief of the section on oil research.

CHAS. N. JORDAN, formerly instructor in chemistry, Marvin College, Fredericktown, Mo., is now engaged in chemical and metallurgical work for the Ordnance Department.

DR. R. E. NELSON has resigned his instructorship in chemistry at Purdue University to accept an appointment as assistant gas chemist in the Research Division, Chemical Warfare Service, American University Experiment Station, Washington, D. C.

AT the Oregon Agricultural College, Dr. A. C. Chandler, assistant in the department of zoology, and F. H. Lathrop, research assistant in entomology, have received commissions as second lieutenants in the Sanitary Corps and have been granted leave of absence for the duration of the war.

PROFESSOR C. K. LEITH, of the University of Wisconsin, has been appointed mineral adviser to the War Industries Board from the standpoint of the conservation of shipping.

PRESIDENT KENYON BUTTERFIELD, of the Massachusetts Agricultural College, has become a member of the Army Educational Commission appointed to provide educational opportunities for the American Expeditionary Forces.

DR. R. A. PEARSON has resigned as assistant secretary of agriculture so that he may resume his duties as president of the Iowa State College of Agriculture. He will be succeeded by G. I. Christie.

AT the Bureau of Fisheries Glen C. Leach, field superintendent, has been promoted to the position of assistant in charge of the division of fish culture, in succession to Henry O'Malley.

MR. HENRY M. EAKIN, formerly with the Alaska Division of the U. S. Geological Survey, has entered the employment of a large lumber company in Alger, Washington, as topographer and forester.

DR. R. P. CALVERT has been transferred from the position of head of the general chemical division of the Experimental Station, Wilmington, Del., to that of director of Delta Laboratory, Arlington, N. J. Both laboratories are under the direction of the chemical department of E. I. du Pont de Nemours & Company.

CHARLES S. REWE, chemist of the United States Office of Public Roads and Rural Engineering, has entered the Research Department of the Barrett Company, New York City.

N. H. DARTON, of the United States Geological Survey, spent August and September in New Mexico continuing his investigation of stratigraphy of the Red Beds especially as to their prospects for containing potash deposits.

PROFESSOR MAXWELL-LEFROY, professor of entomology at the Imperial College of Science, London, has accepted a year's engagement with the Commonwealth Government for £3,000, plus £2,000 for experiments. He will investigate the blowfly, the grain weevil, the woolly aphis, prickly pear and the St. John's wort.

Dr. C. Chilton, professor of biology at Canterbury College, New Zealand, has been elected an honorary member of the Royal Society of New South Wales.

Professor Aaron Nicholas Skinner, formerly professor of mathematics at the U. S. Naval Academy and assistant astronomer of the Naval Observatory, died on August 14, in his seventy-fourth year.

Mr. Robert Christian McKinney, for many years a member of the topographic branch of the U. S. Geological Survey, has died on July 27, at the age of sixty-two years.

Colonel Bertram Hopkins, professor of mechanism and applied mechanics in Cambridge University, died on August 26 in an aeroplane accident.

Professor O. Henrici, F.R.S., emeritus professor of mechanics and mathematics in the Central Technical College of the City and Guilds of London Institute, died on August 10, at the age of seventy-eight years.

Stonehenge, the famous Druid monument, which has always been in the hands of private owners, has been presented to the British nation by C. H. E. Chubb, who purchased it in 1915.

The statutory meeting of the general committee of the British Association for the Advancement of Science, was held in London in July, and at this meeting much disappointment was expressed that for the second year in succession it has been found impossible to arrange for an ordinary meeting. A resolution was passed unanimously asking the council to arrange for a meeting in London next year, if it should prove impossible to arrange to meet at Bournemouth. The question as to the type of meeting which it was desirable to hold was left to the council to decide.

The Illuminating Engineering Society will hold its annual convention at the Engineering Societies Building, New York, on October 10, 1918. War-time lighting economies, the use of better lighting in speeding up war production and manufactures, the lighting of camps, effect of lighting curtailment on crime, and automobile headlight laws will be discussed.

The Association of American Agricultural Colleges and Experiment Stations will hold its thirty-second annual convention at the Southern Hotel, Baltimore, Md., November 13–15.

The council of the Royal Microscopical Society announces that the high cost of printing and the growing scarcity of paper have compelled them to reduce the issue of the *Journal* to four numbers per annum instead of six. The revenue account of the society for 1917 showed an excess of expenditure over income of £141.

The committee of organization for the South American Conference on Hygiene, Microbiology and Pathology, to be presided over by Professor Couto, has decided on Rio de Janeiro for the inaugural session. It will convene on October 15. The previous meeting was held at Buenos Aires in September, 1916.

The *Journal* of the American Medical Association states that the commission sent by the National Public Health Service to study epidemic diseases in northern Argentina is under the leadership of Professor Kraus, director of the Instituto Nacional Bacteriologico. The other members of the commission are Drs. de la Vega, Battaglia, Barbara, and Fischer, with several bacteriologists, *guardas sanitarios* and attendants. The epidemic of pneumonia at Jujuy has almost completely died out, but the mortality reached 30 per cent. In the Galpon and Molinos districts there have been cases suspicious of bubonic plague and the commission is to investigate these foci. A large squadron is equipped for rat destruction at these places. The main interest for the expedition, however, is the investigation of typhus, for exanthematous typhus has never been reported before in Argentina. The suspicious cases which the commission is to study have occurred at Iruya, near the frontier of Bolivia, in a poor, mountainous zone with little communication with the outside.

Nature states that the position of Great Britain as regard the supply of optical glass at the outbreak of the war is often not clearly understood. Optical glass has been manufac-

tured in this country since 1848 by Messrs. Chance Bros., and Co., Birmingham. When the supply of German glass was cut off in 1914, the experience gained by this firm became an important national asset, and through it an acute situation was saved. Messrs. Chance have supplied nearly the whole of the optical glass required for instruments used by British forces during the war, and also much of the requirements of the Allies, without any assistance from the formula determined by the Glass Research Committee of the Institute of Chemistry. This committee rendered invaluable aid to the manufacture of scientific and heat-resisting glassware, but the needs of optical-instrument makers were met independently by Messrs. Chance, whose output since the outbreak of hostilities has increased twenty-fold. Without their seventy years' experience it would have been very difficult to have produced the supply of optical glass imperatively demanded by conditions of war.

PRESIDENT WILSON has issued a proclamation establishing three new national forests in the East—the White Mountain, in Maine and New Hampshire, the Shenandoah, in Virginia and West Virginia, and the Natural Bridge, in Virginia. The White Mountain National Forest is located in Grafton, Carroll and Coos counties, N. H., and Oxford county, Me. The Government has actually taken title to about 267,000 acres, and in addition about 124,000 acres more have been approved for purchase, making a total of about 391,000 acres under Federal protection. This forest protects in part the watersheds of the Androscoggin, Saco, Connecticut and Ammonoosuc rivers. The Shenandoah National Forest is situated in Rockingham, Augusta, Bath and Highland counties, Va., and Pendleton county, W. Va. The government has acquired to date slightly in excess of 100,000 acres and an additional area of approximately 65,000 acres has been approved for purchase, making a total of approximately 165,000 acres under Federal protection. The forest is for the most part on the watershed of the Shenandoah river and it also protects a portion of the watersheds of the Potomac and the James. The Natural Bridge National Forest is situated in Rockingham, Nelson, Amherst, Botetourt and Bedford counties, Va. The federal government has actually acquired title to a little over 73,000 acres, and an additional area of approximately 29,000 acres has been approved for purchase. The forest, which protects a portion of the watershed of the James river, does not include the Natural Bridge, but this scenic feature is within three or four miles of the boundary.

As a means of combating tuberculosis and other communicable diseases besides elevating the general health conditions throughout the state, the Oklahoma Association for the Prevention of Tuberculosis is conducting a series of general surveys of cities throughout the state. The surveys are in charge of Mr. P. Horowitz, of the department of biology and public health, Massachusetts Institute of Technology, and Dr. Gayfree Ellison, professor of bacteriology and hygiene of the University of Oklahoma. The investigators are assisted by members of the executive and nursing staff of the State Association, as well as by the staff of the State Board of Health and the Board of Argiculture. The surveys, which began on April 1, are continued through the month of September. The following towns are included in the study: Oklahoma City, Tulsa, Muskogee, Enid, Shawnee, Bartlesville, Ardmore, Chickasha and McAlester.

THE United States Bureau of Education has recently issued a Union List of Mathematical Periodicals prepared by Professor David Eugene Smith and Dr. Caroline Eustis Seely. This list contains the leading mathematical periodicals needed by research students and to be found in a number of the larger libraries in various parts of the country. Copies may be secured by addressing the United States Commissioner of Education, Washington, D. C.

A HISTORICAL sketch of the observatory of the University of Cincinnati has recently been written by Dr. J. G. Porter, director of the observatory. The Cincinnati Observatory has been in operation since 1843, when it was

established by Professor O. M. Mitchell, professor of astronomy in the old Cincinnati College. Through the generosity of Nicholas Longworth a site for the observatory was secured and telescopes were mounted in 1845. In 1873 the observatory was made the astronomical department of the University of Cincinnati, and the present site on Mt. Lookout was donated by John Kilgour. Professor Mitchell was an innovator, publishing the first American magazine devoted to popular astronomy, and applying the principles now embodied in the chronograph to the recording of time. The scientific achievements of the observatory are well known, among them being the detection of double stars, orbits of comets, prediction of the weather and the study of nebulæ. For years the problem worked on by Dr. Porter and his assistants has been the proper motions of the stars. The few thousands of stars which show sufficient motion to be perceptible, in the interval during which astronomers have had them under observation, have been reobserved at Cincinnati and their motions carefully investigated.

UNIVERSITY AND EDUCATIONAL NEWS

Stonyhurst College, Blackburn, England, has planned to raise £20,000 as a war memorial to be devoted chiefly to the erection of new science laboratories.

Columbia University, at the request of the War Department, is starting an emergency course in engineering for students entering from high schools. This emergency course, embracing civil, electrical, mechanical, metallurgical and chemical engineering, will extend over two years of four quarters each. The first four quarters of the course will be devoted largely to fundamental scientific training in mathematics, physics and chemistry. The strictly engineering subjects will come in the second year. The War Department does not guarantee that any man entering on this course can remain to finish it, but those who do well will be continued in it as long as the needs of the army permit.

Lieutenant Colonel Charles F. Craig, who until recently has been stationed at Fort Leavenworth, Kans., has been placed in charge of the Yale Army Laboratory School, the new school for bacteriologists and chemists which is to be conducted at Yale University during the period of the war.

Dr. R. M. Strong, professor of anatomy at Vanderbilt University, has been appointed professor and head of the department of anatomy at the Chicago College of Medicine and Surgery.

Dr. Joseph C. Bock, Chem. Eng. (Vienna), Ph.D. (Cornell), for five years instructor at Cornell University Medical School, has been appointed professor of physiological chemistry in the school of medicine of Marquette University at Milwaukee.

E. J. Quinn, who for the past four years has been a research chemist on the chemistry staff of the Montana Experiment Station has accepted an appointment as assistant professor in the department of chemistry of the State College of Agriculture and Mechanic Arts of the University of Montana. He will have charge of the courses in analytical and agricultural chemistry.

Mr. S. H. Stroud, formerly demonstrator in chemistry in the School of Pharmacy, Bloomsbury Square, has been appointed lecturer in pharmacy and chemistry in the University of Sydney, N. S. W.

DISCUSSION AND CORRESPONDENCE

THE FOUNDATIONS OF MECHANICS

In Science of August 2, Messrs. Franklin and MacNutt attempt to make it "clearly evident that Professor Huntington's statement (that variation in acceleration from body to body for a given force is logically derivable from the variation from force to force for a given body) is not true." "Logically derivable" is scarcely a clear phrase in this connection. The *quid* of the matter is found, of course, in the fact that in the table of Messrs. Franklin and McNutt, these authors

have chosen to use three "identifiable" forces. According to their logic, they must mean that their forces are identifiable but not measurable, and further that you can not measure force until you bring in the idea of mass. The distinction between "identifiable" and measurable" seems to me to be valueless. Moreover, mass is in no way *necessary* either for the identification or measurement of forces. As Perin[1] observes. if a stretched spring A balances two stretched springs $M + N$, then force $A =$ force $M + N$. Messrs. Franklin and McNutt emphasize the fact that mass is independent of time and place and exists independent of any gravitational field. So does the science of mechanics. Messrs. Franklin and McNutt's own logic should, then, force them to the conclusion that for all bodies, where F is measured independently of mass

$$f/a = \text{constant} = m \qquad (1)$$

and the constant is defined as mass.

A much deeper source of confusion is found, however, in not making the distinction between mechanics as a "doctrinal function" to borrow Bertrand Russell's term and as an experimental science. If we put

$$x = y/z \qquad (2)$$

we have asserted nothing, since no interpretation has been placed on x. y and z. So, in fact, we might go ahead and develop the whole of (mathematical) mechanics without interpreting the symbols at all, or specifying merely that they might be anything consistent with the fundamental equations or postulates and of course with the theorems deduced. Such a body of doctrine is Veblen's[2] system of axioms for geometry. The system has no necessary connection with space or geometry at all; but when for the one undefined element, we put "point" the doctrinal function becomes applicable to space. But we could substitute something else—and that non spatial—and get an equally good application. So if we let $x = m$, $y = f$ *and* $z = a$, we have equation (1), which we assert is true from experience or experiment.

There is of course no objection to having as many postulates as we please or as the case requires provided they are consistent. Elegance also requires that they be independent. For a start, let us put

$$m = f/a \qquad (1)$$

$$f = k(m_1 m_2/r^2) \qquad (3)$$

where K is the constant of gravitation. These two postulates are obviously both consistent and independent. There is a double definition of mass,—*i. e.,* mass as inertia, and mass as capacity to be attracted in a gravitational field. In the doctrinal function we *postulate* the *m's* (whatever they represent, if anything) identical. By experiment we say mass by one definition equals mass by the other. Similarly, a chemical compound is something that (at least) fits into the equations of Gibbs' paper "On the Equilibrium of Heteoogeneous Substances." It is intended, of course merely to indicate a line of thought, not to develop it.

Thus it is clear that the units we have in the Bureau of Standards need not be the same as the undefined elements in the doctrinal function. We do not need even to imagine that Bureau keeping standard springs, rubber bands, strong armed men, etc., and more than it would have to keep a standard point (!) instead of a standard meter, for Veblen's system of geometry. Any equation may be made use of to measure any quantity which it contains.

There remains the formal possibility that we might find by experiment that the mass of (1) is not the same as the mass of (3). A doctrinal function corresponding to mechanics would not be affected, but a new one would have to be made corresponding to the new experimental fact, provided we wished to define mass, in part, by making use of gravitational pull, that is, to retain a postulate comparable to (3) along with (1). But this last is not necessary, since $f/a = m$ is a sufficient definition of mass, and has nothing to do with

[1] Perrin, "Traité de Chimie physique," Paris, 1903.

[2] *Transactions of the American Mathematical Society*, Vol. 5, p. 343.

gravitation that we can explain further. It is the real definition of mass, and (3) is a useful additional postulate, or a useful experimental fact.

So far as ease of thinking is concerned, which is more or less irrelevant, force and acceleration are far more easily grasped than mass. *That is to say, it appears so to the* writer; but Frederic Soddy[8] says: "the conception of force and its pseudo physical reality undoubtedly delayed for centuries the recognition of the law of the conservation of energy. Only what is conserved has the right to be considered a physical existence. In other branches of science, the conception is a stumbling block and a delusion." Perrin takes a radically different view. There seems to be a certain mysticism in Soddy's contention, for what do we care whether a force goes on "existing" when we finish with it? We find velocities and temperatures convenient, yet they go out of "existence" without any special regret. The main fact is we can give numbers to these forces, temperatures, etc., and make equations that correspond (somewhat) to experiments.

Mass, on the other hand, means (1) inertia. (2) capacity to be attracted by a gravitational field (3) capacity to create a gravitational field, and some other things. It appears to depend on velocity, though it is not intended to consider non-Newtonian mechanics. It is about as puzzling a thing as there is in physics —for who knows what gravitation is?

PAUL J. FOX

1203 STOCK EXCHANGE,
PHILADELPHIA

NONSILVERABLE CONTAINERS FOR SILVERING MIRRORS

IN the ordinary process of silvering glass mirrors by chemical decomposition (*e. g.*, Brashear's method) the metal is deposited upon the glass container. In this manner a great deal of silver which might have added to the thickness of the mirror is lost. This is an important item when silvering mirrors 25 cm. or more in diameter.

[8] "Matter and Energy," New York, 1912, p. 108.

The object of this note is to call attention to the usefulness of ordinary, "granite ware," enamelled iron pans, which do not attract the silver and hence increase the supply of material available for deposition on the mirror. This was observed some years ago, but its importance was not very apparent. However, during the past year the writer has had frequent opportunities to verify this observation and to apply it in producing thick deposits of silver on glass.

WM. W. COBLENTZ

BUREAU OF STANDARDS,
September 9, 1918

QUOTATIONS

SCIENTIFIC WORK IN INDIA

THE Board of Scientific Advice for India has, like similar bodies elsewhere, felt the effect of war conditions. The board has been strengthened by the addition of a representative of the Indian Munitions Board, and power has been conferred upon the president to appoint subcommittees, membership of which need not be confinel to members of the board, for the purpose of dealing with particular investigations. The board has found it necessary to modify the treatment of programs of work submitted by individual scientific departments, and to resolve that the annual report for 1916–17 be confined to a brief statement of work actually done during the year, also that the bibliography of publications bearing on particular subjects be consolidated. But the establishment of a Zoological Survey recorded for the year under notice, has not affected the composition of the Board of Scientific Advice, representation of this subject having been provided for already. That its organization should have been so slightly affected affords striking evidence of the soundness of the original constitution of the board.

The report of the board for 1916–17 is an interesting document, and much of its contents, especially where the applications of science are concerned, may repay perusal outside India. In agriculture the low values of

available phosphate in certain Indian soils—at times only one fiftieth to one twentieth of the amount usually regarded as necessary for fertility—have been under investigation. So, too, have been the low values of available potash in certain other soils. In this connection efforts have been made not only to correlate potash-deficiency with disease in animals and plants, but also to utilize the ash of at least one proclaimed weed as a means of adding potash to the soil, and incidentally as a partial set-off against the cost of eradication. Botanical work has included, in addition to survey operations, much that is of immediate economic importance. One notable instance is afforded by the device of a method of selfing cotton, which is not only simple, but is also said to have proved successful. Much sound work has been done with indigo, jute, opium, rice, sugar and wheat on agricultural lines, and with grasses, as well as trees, on forestry lines.

On the physical side we find that researches in solar physics have included an investigation of the displacement of the lines given by the electric arc. This study has supplied interesting results, and led further to a determination of wave-lengths in the spectrum of the planet Venus with results that are of promise. In geology, besides survey operations, useful economic work has been done in connection with the output of wolfram. Three new meteorite falls—all chondrites—have been reported for 1916–17 from northern India. The most notable item of economic geodetic work for the year has been the taking of hourly readings of a tide-gauge at Basra, erected in connection with military requirements. The constants deduced from the reductions of these readings have been transmitted to the National Physical Laboratory at Teddington, to admit of the tracing of tidal curves for 1917–18. Important also has been the compilation of a list of the plumb-line deflection stations of India and Burma.

The work undertaken in connection with plant- and animal-pathology has been useful and varied. In this relationship an item which deserves attention is an account of practical tests of the use of hydrocyanic acid gas for the destruction of vermin. While less successful than might be desired in the case of houses, this method has proved satisfactory as regards railway carriages and ships.

Appended to the report is a memorandum on work done for India at the Imperial Institute. A striking item in this memorandum is the record of a sample of Assam-grown flax, valued in London under war conditions in December, 1916, at £150 per ton, which was found to compare favorably with the medium qualities formerly received from Belgium.

Perhaps the time is approaching when a body, similar in its functions to this Indian board, may be brought into being so as to ensure for the scientific departments of our various Crown Colonies that correlation of effort which, as this report testifies, already so happily attends the operations of the different scientific departments of the Indian government.—*Nature.*

SCIENTIFIC BOOKS

Plant Genetics. By JOHN M. COULTER and MERLE C. COULTER. The University of Chicago Press. 1918. Pp. 214.

As the authors state the book is neither a technical presentation of genetics nor a general text, but is the outgrowth of a course of lectures designed to give general students of botany a brief introduction to the subject of genetics. This has been attempted in some 200 small pages with numerous diagrams. It is written for younger students than the books on genetics which have so far appeared. Necessarily a minimum of illustrative material has been used and the complex features are omitted altogether or are only briefly alluded to.

An account of the earlier theories of heredity and a discussion of the inheritance of acquired characters opens the book followed by several chapters on Mendelism. The simplicity of the examples of the various types of Mendelism and the diagrams to illustrate them is a real achievement. Some misrepresentations of facts are to be noted here which are hardly

excusable even on the plea of pedagogical necessity. For example in the treatment of Mendel's pea hybrids the "wrinkled-smooth" seed character is given as similar in time of expression to the "tall-dwarf" plant character which in inheritance is one generation later in its apparent effect so that the statement that first generation dihybrid plants will all be tall and smooth-seeded individuals would be quite confusing to the beginning student if he repeated such an experiment for himself. For the purpose of illustrating the behavior of a dihybrid it serves the authors' purpose but there is certainly no lack of material which could be used equally well to illustrate this point without alteration of the actual facts.

The work of East, Shull, Emerson, Blakeslee and many others is freely drawn upon in bringing out the different phases of the subject. The chapters of chief interest to the geneticist are those on Parthenogenesis and Vegetative Apogamy, Inheritance in Gametophytes, and the Endosperm in Inheritance. A number of facts in regard to sex determination in plants have been gathered together. All these subjects have usually been scantily treated in books on genetics.

In the opinion of the writer the authors were not wise in including the complex subject of sterility in an elementary book of this kind especially as it is treated in the chapter on self-sterility. The beginning of the chapter emphasizes the importance of self-sterility as a means of insuring cross-pollination while the remainder is largely devoted to Belling's work on semi-sterility which has no significance in this connection. No clear distinction is made between the different types of sterility which would seem desirable if the subject is to be discussed at all. A chapter is devoted to the subject of hybrid vigor and the book closes with an able summary of the theoretical points involved in a consideration of the chromosomes as the bearers of the hereditary determiners.

Throughout there is shown a first-hand unfamiliarity with the genetical experiments discussed. In spite of this handicap a really useful book, for those not primarily interested in genetics, has been produced which shows the authors' ability to coordinate many different, specialized fields of investigation and to put the results into an easily read form. The book is designed to fill an important place which would justify more care in the choice of material and in its presentation. The practise followed of giving few facts and discussing them in all their important relations to each other and to other fields of biology is perhaps the most valuable feature of the book.

D. F. Jones
Connecticut Agricultural Experiment Sta.,
New Haven, Conn.

THE POWER SITUATION IN THE UNITED STATES

Two of the most important domestic problems facing the United States at the present time concern the supply of power necessary to maintain the industrial activities of the country, and the adequacy of transportation to move the raw materials and finished products involved in these activities. As the coal consumed in the United States engages over a third of the freight capacity of our railroads, and more and more coal is being used, the result is a growing burden upon transportation which must be relieved. The power problem and the transportation problem, therefore, are really different expressions of a single fundamental issue. In this connection the United States National Museum, Smithsonian Institution, has just issued a 50-page Bulletin, entitled "Power: Its Significance and Needs," which gives an analysis of the whole situation and presents a plan whereby the problems of water-power, coal-supply, and transportation may find a solution. This contribution is by Chester G. Gilbert and Joseph E. Pogue, of the Division of Mineral Technology, and is Part 5 of Bulletin No. 102, the Mineral Industries of the United States, which has already dealt constructively with such matters as coal-products, fertilizers, domestic fuel and petroleum.

Quoting from the conclusions of the authors of this Bulletin, it is stated:

The righting of the power situation requires (1) the establishment of a comprehensive system of electric transmission lines to be administered as a common-carrier system like the railways. (2) The provision of such a system will necessitate the coordinated growth of central power stations in coal fields and at water-power sites, and in doing so will open to business enterprise a tremendous field of opportunity hitherto closed off from entry, and thus lead to the balanced development of the two major energy resources, coal and water-power. (3) The principle of multiple production, recognized and incorporated in national policy, will supplement the additional service gained through the organized employment of the electrical principle; applied to the production of coal-generated electricity, and, through the medium of municipal public utility plants, to the distributive employment of coal, this principle will effectively correlate the recovery of the commodity and energy values, so as ultimately to effect a full saving of the former and an increased gain of the latter, thus permitting a further relative diminution of the amount of fuel calling for transportation in bulky form. The first two points reduce themselves to a single issue, which is purely a business proposition to be handled by a business organization; the third item is more intangible and it is a matter of policy, which, therefore, can not be delegated or otherwise handled in objective fashion.

The provision of a common-carrier system of transmission lines, in brief, is the key to the whole problem. Its establishment will remove the retarding influence of high interest rates and antagonistic misunderstanding that has blocked water-power development, and will afford the point of departure from precedent in favor of coal-field generation of electricity. Owing to the magnitude of the issue and the manifold lines of progress directly at stake, the development will provide a nuclear point for the establishment of a constructive economic policy, needed not merely for the full development of this field but as well for proper unfoldment of the industrial possibilities of the country in general. As such a policy has not developed in the past because of economic sectionalism growing chiefly out of an unequalized development of the energy resources, the nationalization of industrial opportunity attainable through a balanced development of power supply will clear the path of the main obstruction to unified action.

Thus specific action in respect to establishing a common-carrier system adapted to the power needs of the country will not only go far toward solving the problem of transportation, but it will improve the fuel supply, correct the economic fallacy of drawing upon capital resources while neglectful of income, contribute to the recovery of the values now lost in the consumption of raw coal, lead to an adequate development of electrochemical activities, cut off a needless annual expenditure running well beyond the billion dollar mark, and constitute a potent contribution in the direction of stimulating the upgrowth of a constructive economic policy of national scope attuned to the needs of modern industrial development. It is believed that these results would involve national economies, offsetting in large part the cost of the war.

SPECIAL ARTICLES

THE COEFFICIENT OF EXPANSION OF LIVING TREE TRUNKS

The present investigation was undertaken as a continuation of the work of the late Professor C. C. Trowbridge, of the Department of Physics, Columbia University, on the movements of the branches of trees, with the object of inquiring into the mechanism of these movements. Part of the work had been carried out in collaboration with Professor Trowbridge.

The measuring apparatus, as devised by him, consisted of a rod of invar, with four steel knobs set on short steel posts fitted into the rod near one end, at intervals of ninety degrees, and also with one or more small brass blocks in the form of square prisms, fitted over the rod at some distance from that end. A steel-pointed block and a conical steel socket were attached to the tree under investigation, and a measurement was made by holding one of the steel balls in the socket, and making a light scratch on the brass plate by gently drawing it over the steel point. A careful record was kept of the exact position on the brass plate of each of the scratches made, and the distances between them were measured under the microscope. In the tests made previous to the tree-trunk work, the instrument was found to be suitable for general laboratory work as well as

[1] C. C. Trowbridge, "The Thermometric Movements of Tree Branches at Freezing Temperatures," *Bulletin of the Torrey Botanical Club*, 43, No. 1, pp. 29–56, 1916.

for special types of investigation. Together with each measurement a reading was taken of the air temperature as given by a mercury thermometer attached to the tree, as well as the reading of one or more thermometers inserted into the tree to various depths.

Observations were made on a European linden tree (*Tilia europæa*), and a plane tree (*Platanus orientalis*), both on the campus of Columbia University. The observations extended from February 2 to May 19, 1917, and from December 22, 1917, to April 25, 1918. During the first winter, observations were made on both of these trees, but attention was confined to the linden tree alone during the second winter, as the same effects were observable here to a far more marked degree. During both winters, longitudinal and transverse measurements were made, a separate point and socket being used for each, and a longer rod being used for the longitudinal observations, as the longitudinal changes were, as a rule, much smaller in amount. An extended series of measurements was also made on the changes in the circumference of the tree and on frost cracks, during the second winter. Three interior thermometers were used in the first winter's observations, four in the second, one extending to a somewhat greater depth than the deepest of the previous winter. No observations were made during the summer, as it was found that at ordinary and high temperatures, the changes in dimensions were extremely slight. Observations were made from one to four times a day, and readings of the various thermometers were sometimes taken more frequently. During the winter of 1917–18, the writer made 109 sets of measurements, and about the same number during the preceding winter.

The second winter's observations fully confirmed the earlier series, and added some new results. In regard to the transverse measurements, it was found that above 32° Fahrenheit there is a slight expansion with rise in temperature, while below that temperature the changes are far more marked. As the temperature falls below 32° Fahrenheit there is a very marked transverse contraction. The difference in the changes above and below freezing may best be illustrated by stating, in the case of the linden, that above the freezing temperature, the coefficient of expansion is nearly the same as that of dead wood, *i. e.*, of the order of 5×10^{-6}, while below freezing it is some fifty times as great.

The transverse change in dimensions of the tree, below freezing, usually lags behind the change in temperature of the bark by several hours at least, often as much as twenty-four hours. When there is a sudden change in the temperature of the bark, the contraction is rapid, but not synchronous. With a rise in temperature, the lag, as a rule, is relatively greater. It is probable that the temperature at a depth of four or five inches has little or no influence on the changes in transverse dimensions.

In the case of longitudinal measurements the fact was revealed that below the freezing temperature there is a minute but extremely definite *increase* in length with *fall* of temperature, and that above freezing, there is an equally minute *increase* with *rise* of temperature. At extremely low temperatures, near zero, Fahrenheit, however, there is a small *contraction* with fall of temperature, but when the temperature rises again, the expansion is extremely rapid, and by the time the temperature is again the same as before the drop, the tree is very much longer than previously.

In this series of measurements at very low temperatures, there is distinct evidence of two changes—thermal and physiological, apparently acting in opposite directions. At slightly higher temperatures the thermal change is not so much in evidence, and so, as a rule, only the physiological expansion with drop of temperature is observed. There is evidence of a lag of longitudinal expansion and contraction behind the temperature of the bark of the tree, but excepting at the lowest temperatures, the phenomenon is not clear cut, as in the case of the transverse measurements, and the details have not as yet been worked out.

A very extended series of measurements was made on the circumference of the linden tree,

and it was found that, as a rule, the expansions and contractions were in the same direction as for the transverse measurements, but yet this was not always the case. The changes in circumference were found not to be proportional to the transverse measurements. After more than four months, when the temperature was much higher than at the time observations were begun, the circumference of the tree was still *smaller* than when the first observations were made. The method of making observations on the circumference consisted in measuring, with a pair of dividers, the distance between two scratches on a painted steel tape surrounding the tree, and continuously left in contact with it. When the series of observations was begun, two scratches were made, one on each of the two parts of the tape which lay, one directly above the other, and, as the circumference changed, the distance between these scratches was recorded. These measurements were made several times a day, and showed that the final contraction, which Grossenbacher[2] thought might possibly be due to an error in his measurements, is an actual experimental fact. Grossenbacher's observations were made at intervals of several weeks, and his tape was removed after each observation.

An equally extended series of measurements on frost cracks was made during the winter of 1917–18. It was found that during the coldest weather when the crack was open about three fourths of an inch, its depth at certain points was more than ten inches. Also, in addition to the large crack formed on the south side of the linden tree, another was formed on the north side toward the end of January, 1918, and the change in the width of the two cracks seemed to follow the same law, *i. e.*, the cracks became wider as the temperature fell, and narrower as it rose again.

From the measurements on the transverse changes, on the circumference and on frost cracks, the conclusion was reached that frost cracks are caused by a tearing apart of the tissue of the tree, due to a great *contraction*. Both the circumference and the transverse dimensions are much less when the crack is open than when it is closed, and the one is not proportional to the other.[3] Frost cracks are probably due to a difference in the coefficients of radial and tangential contraction of the tree, a difference which sets in at approximately 25° Fahrenheit (about 4 degrees below zero Centigrade). If the cells of the tree collapse in a tangential direction (a fact which was observed) and the changes along the medullary rays are not as great, then the tree will split open, due to the increased tension. If the cells again expand tangentially, the crack will close due to increased pressure, provided the radius may not change in dimensions at all, it may expand to a greater extent, or it may even contract; in any case the crack will close. The first or third of these cases would account for the observation that after the crack has closed, the circumference of the tree is less than before it opened. These conclusions are, however, tentative and approximate, due to the complications caused by the lag in the tangential direction, the temperature gradient through the tree, and other difficulties which must still be studied, before a more complete explanation can be given.

C. C. Trowbridge,[4]
Mabel Weil
Phœnix Physical Laboratories,
Columbia University

[2] J. G. Grossenbacher, "Crown-Rot of Fruit Trees, Field Studies," N. Y. Agricultural Experiment Station, Geneva, N. Y., Technical Bulletin, No. 23, September, 1912, pp. 35–37.

[3] Some similar conclusions were reached by a different method by Caspany, *Bot. Zeit.*, 15, 1857.

[4] Deceased.

THE DEPTH OF DOLOMITIZATION[1]

In a recent issue of the *American Journal of Science*,[2] there appeared an article by E. W. Skeats on "The Formation of Dolomite and its Bearing on the Coral Reef Problem." The author of this paper adopts the replacement theory of the origin of dolomite and presents

[1] Published with the permission of the Director of the Iowa Geological Survey.

[2] Volume XLV., 4th Series, pp. 185–200, March, 1918.

evidence in favor of the view that regional dolomites are of shallow water origin. The bearing of this conclusion upon the coral reef problem is made clear from the following quotation:[8]

> The author regards the evidence of dolomitization of fringing reefs of coral islands, the occurrence of dolomite immediately below phosphate beds, on the hill tops of Christmas Island, the rise in the magnesian content of the limestones of the Funafuti bore between 15 and 30 feet, as definite and strong evidence of the shallow water origin of dolomite in coral islands. It is claimed that this view is consistent with the chemical evidence quoted above of the reversal of the solubilities of calcium and magnesium carbonates in carbonated water between the pressures of one and four atmospheres. In addition, the evidence, cited above from more ancient dolomites showing their intimate associations with independent evidence of shallow water such as fossils, current bedding, conglomerates, and oolitic structures, is so consistent and so in accordance with the evidence from modern coral limestones, that the author takes the view that wherever a "contemporaneous" or regional dolomite is found to occur, it may be regarded as having originated in shallow water. If this be granted, it follows that such upraised coral islands, like Ngillangillah, now 510 feet high, and Vatu Vara, now 1,030 feet high, which are dolomitized from top to bottom, must have originally been formed of shallow water limestones accumulated by subsidence to at least 500 to 1,000 feet respectively before elevation set in. The atoll of Funafuti whose surface is practically at sea level must have been built up of shallow water limestones accumulated during subsidence, which must have amounted to about 1,100 feet at least since the cores from 635 feet to 1,114 feet consist entirely of limestones which have passed through the process of dolomitization.

In the writer's experience with regional dolomites of undoubted secondary origin, he has encountered considerable evidence in support of the contention that many of them represent shallow water deposits, but he is not yet prepared to conclude that all replacement dolomites are of this origin. The most striking evidence bearing on this question that has come to the writer's attention, has been obtained in connection with his study of the limestones of the Osage and Meramec series, of Mississippian age, in the Mississippi Valley.

[8] *Ibid.*, p. 200.

In Ste Genevieve county of southeastern Missouri, these limestones, with one exception, possess all the ear-marks of clear, open sea deposits (see table). They attain their maximum development there, are all, with the exception of the Warsaw, unusually pure, and, barring a small break of local significance at the base of the Warsaw, are conformable. The paucity of dolomite in this thick series of limestones is remarkable. With the exception of an impure bed of dolomitic limestone in the upper portion of the Warsaw, which may well be of clastic origin, and a thin, imperfectly dolomitized layer in the Saint Louis at the station of Little Rock, no dolomite was observed during a careful study of the whole section.

TABLE

Series	Name of Formation	Thickness in Feet
Meramec	Saint Louis limestone	150
	Spergen limestone	160
Osage	Warsaw formation	150
	Keokuk limestone	30–40
	Burlington limestone	75

In southeastern Iowa and adjacent portions of Illinois, on the other hand, very different conditions are met with. In this region all the formations show indications of having been deposited in shallow, oscillating seas, the evidence being most pronounced in the Spergen and Saint Louis limestones, and dolomite is a very important constituent of every member of the series.

The Burlington limestone maintains approximately the same thickness here as in southeastern Missouri, but beds of brownish, impure dolomite, some of which pass locally into shale, are interbedded with the limestone and constitute more than fifty per cent. of the formation.

The Keokuk consists of interbedded layers of shale and limestone, some of the latter being dolomitized locally; and the Warsaw is made up chiefly of argillaceous shale but bears occasional lenticular beds of limestone, some of which are imperfectly dolomitized.

The Spergen limestone of southeastern Iowa

is very different from that of southeastern Missouri, and much confusion attended the earlier attempts to refer this formation to its proper position in the series. This confusion was evidently due, in large part, to the failure of earlier workers to recognize the disconformities at the base and at the top of the formation. The apparent tendency of the Spergen to grade laterally into the Warsaw or the Saint Louis has resulted entirely from these relationships. In addition, the Spergen is very variable in lithologic character in this region, due in part to original conditions of sedimentation, and in part to differences in the degree of dolomitization. It is not uncommon to find a cross-bedded, crinoidal limestone passing laterally within a short distance through imperfectly dolomitized limestone into massive, brown dolomite, and this again into a brownish arenaceous dolomite, which may in turn give way to a fine-grained, bluish sandstone. Such rapid changes clearly indicate near-shore conditions during deposition. This is also suggested by the limited extent of the formation in Iowa. and by its rapid thinning to the northwest. Its thickness in this region varies from 0 to 35 feet.

The Saint Louis limestone of Iowa also shows marked evidence of shallow conditions during deposition, although it has a much more widespread distribution than the Spergen. It consists of two distinct subdivisions separated from one another by a disconformity. For convenience these may be designated as the Lower Saint Louis and the Upper Saint Louis. The Lower Saint Louis is by far the most extensive of the two members. This extends far to the northward, overlapping all the earlier formations of the Mississippian except the Kinderhook, upon which it rests in Humboldt county. It consists for the most part of massive beds of compact, dolomitic limestone, but frequently these are found to grade laterally into gray, non-dolomitic limestone within short distances. At most localities, the lower beds are arenaceous. Ripple marks and cross-bedding may appear locally at any horizon. In southeastern Iowa, mound-like reefs of limestone with undisturbed layers lapping up on their flanks are occasionally found in the formation. These were evidently formed by wave action during deposition. The thickness of this division is about thirty feet. The Upper Saint Louis consists for the most part of light gray compact limestone which is locally dolomitized either wholly or in part, and shows the same evidence of shallow water deposition as the Lower. Locally this division passes laterally into sandstone in part. The Upper Saint Louis seldom exceeds twenty-five feet in thickness.

The writer has observed further evidence of the relation of the extensive dolomitization to the shallow water zone in the Cedar Valley limestone, of Upper Devonian age, in Iowa. In Johnson county, which is located a short distance south of the east-central portion of the state, this formation has an exposed thickness of approximately one hundred feet and consists of fairly pure, gray fossiliferous limestone almost entirely devoid of dolomite. But in Mitchell, Howard, Winneshiek and other counties in the northern portion of the state, the Cedar Valley is made up of interbedded limestone and dolomite, and bears evidence of having been deposited in shallow seas. The beds are impure, shaly partings are common between the layers, and evidences of contemporaneous erosion are frequently encountered.

The suggestion is ventured that careful study of other Paleozoic limestones will disclose similar evidence of more extensive dolomitization in their shallow water facies.

Francis M. Van Tuyl
Colorado School of Mines

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, OCTOBER 11, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

A GEOMETRIC BASIS FOR PHYSICAL AND ORGANIC PHENOMENA

THE following notes refer to certain ideas which the writer has had in mind for many years, but in the form now submitted they are immediately suggested by a recent casual examination of D'Arcy W. Thompson's "Growth and Form" (Cambridge University Press, 1917) and particularly by reading certain paragraphs in this book relating to the various possible divisions of space by systems of surfaces or material films and membranes, in connection with a discussion of the internal structure of organic bodies.

A number of years ago the present writer submitted a brief paper to the American Physical Society under the title "A simple geometrical principle and its possible significance in connection with a general physical theory." The principle was stated as follows: "In any aggregation of an indefinite number of equal spherical bodies an arrangement giving minimum total volume occupied and perfect symmetry throughout is impossible." The quotations are from memory. An abstract of the paper was published at the time in the *Physical Review.*

Of course this principle might be dealt with by geometrical construction and mathematical analysis, but it can be demonstrated experimentally and in a simple and practical way by means of a number of balls of equal diameter like the hollow celluloid "ping-pong" balls, or the rubber balls sold as children's playthings. Thick mucilage, varnish, collodion, sealing wax or any other available adhesive substance may be used for sticking the balls together. Perhaps what follows may seem at first too elementary to be regarded as something of real scientific interest, but it is a matter of some surprise to find how many erroneous and confused ideas on so simple a

subject have been entertained and expressed even by scientific writers.

Place one of the balls on the table and arrange four others around and touching it with equal intervals between them in the form of a right-angled cross. Then place one ball directly on top of the central one, and finally one directly beneath it. This forms a group of seven balls which suggests one of the "jack-stones" (generally made of iron or lead) that children play with. The group has a perfectly symmetrical arrangement which admits of indefinite extension on the same system in all directions by the addition of balls. In such a system any one ball, except of course those on the outer boundaries of the assemblage, is symmetrically surrounded by six others all touching the one that is central for this individual group of seven, but no two of these surrounding balls touch each other. The planes mutually tangent to each pair of balls at their common point of contact will obviously form by their intersections a system of equal cubes with common interfaces, each cube circumscribed about a ball. It is plain that these cubes "stack" together so as to make a solid volume, or in other words there will be no voids between—no waste of space. It will be clear that exactly the same arrangement results from placing on the table a number of balls in contact and in a single layer in "square" order, or with the balls in rows both ways at right angles like the squares on a checker board, and then placing another layer in the same formation with each ball directly over a ball of the first layer, and so on. The balls will have to be stuck together or very carefully placed or they will not retain this formation but they will fall down or spread and the pile will collapse under the influence of the gravitation of the earth.

It soon becomes apparent that this cubical arrangement is not the most compact possible or not the one which permits placing the greatest number of the balls in a given volume. For example, after placing the first layer in square formation greater concentration is attained by placing each ball of the second layer over an interval or space among the balls of each group of four in the first layer rather than directly over another ball, and so continuing the succeeding layers.

Now undertake to effect the most compact arrangement possible beginning with one ball, and place about a central ball on the table as many others of the same size as there is room for in one layer with all touching the central ball. There will of course be six side balls, all tangent to each other throughout as well as to the central ball, in hexagonal order. Then three more balls can be placed above touching the central one—and only three, though there are six intervals among the balls of the foundation layer—and likewise three others can be placed below, making twelve surrounding balls or a group of thirteen, all in mutual contact throughout, so that the position of each ball in the group is definitely fixed relative to its neighbors. This arrangement may be extended without limit and it is the most compact possible for an indefinite number of balls, but it is not perfectly symmetrical throughout. The mutually tangent planes at the points of tangency between the balls make a system of rhombic dodecahedrons, each one surrounding a ball. Equal rhombic dodecahedron will stack together without voids when similarly oriented but they do not form a completely symmetrical division of space, since the rhombic dodehedron is not one of the regular polyhedrons, or not a solid with all equal regular polygons for faces. All of the diedral angles of this solid are 120 degrees, but its twelve faces are equilateral oblique angled parallelograms or rhombs and the plane angles meeting at the vertices or solid angles are not therefore all equal.

It should be noted that the formation resulting from starting with a layer in square order and placing the balls of the next layer over the intervals in the first one and so on, is also this same rhombic dodecahedronal arrangement, only differently disposed with respect to the table or the horizontal plane. It is what we so often see in a pile of oranges in the groceries and on the fruit stands. In all horizontal layers of such a pile the balls are in square order, but there are other sys-

tems or series of layers in the pile, inclined to each other and to the horizontal, in which the balls are all in the hexagonal order, which is the closest assemblage possible in any one layer or plane.

We have thus developed one arrangement—the cubical—that gives universal symmetry with the balls in contact throughout, but not maximum concentration; and another one—the rhombic dodecahedral—that gives maximum concentration and density, but not universal symmetry. Now try for a formation that will give both.

The sphere is itself a shape of the most perfect symmetry and it has the very maximum quantity of contained volume or space for a given area of enclosing surface. It seems at first axiomatic and a foregone conclusion that an assemblage of equal spheres *must* admit of an arrangement or grouping that will give to the aggregate collection characteristics exactly similar to those of the individual sphere, with complete internal symmetry and equilibrium.

Recalling that in the second experiment the twelve side balls were placed about the central one all in mutual contact throughout so that the position of each ball in the group was definitely fixed and with no room for relative movement, it will perhaps be somewhat surprising to find that another arrangement for the twelve suronding balls is possible which gives a disposition perfectly symmetrical with respect to the central ball while the balls are nowhere in contact with each other at all, but each is equally and symmetrically spaced from all of its side neighbors. There is room to spare among the side balls but not enough for another ball. In this arangement the common tangent planes between the central and the surrounding balls form a regular polyhedron—the regular or pentagonal dodecahedron—about the central ball. This is a volume with twelve equal pentagons for faces, and of course having all its diedral angles as well as its vertices or polyhedral angles equal respectively. Each diedral angle of this solid, or the angle between any two adjacent faces, is 116° —34′ —54″; that is more than 90 degrees and somewhat less than 120 degrees, or between one quarter and one third of the complete angular space about one edge. Equal volumes or solids of this form may be assembled, face matching face, about a central one of the same size in a group of thirteen, but there must be a wedge shaped void, with a diedral angle at the edge of over ten degrees, between each two adjacent side members of the group where three edges of the solids coincide, and therefore the system can not be extended in the same formation by adding other equal solids of the same size and shape. From this it is apparent that a grouping of spheres inscribed in the equal regular dodecahedrons does not admit of this symmetrical arrangement beyond the group of thirteen.

(A compact grouping of eight equal spheres which is symmetrical with respect to a central point, not within any one of them, may also be arranged as follows: Place three of the spheres in contact on the table, with a fourth over the interval, making a triangular pyramid group or a regular tetrahedral grouping. Then place a sphere over each of the four spaces or openings that will be found over the outer surfaces of the group, each opening surrounded by three tangent spheres. The limit in number for this grouping is eight spheres—there is no available space for any more placed symmetrically—and here is a suggestion of possibly some relation to the "periodic law" of physical chemistry).

To summarize: The only possible arrangement or grouping of equal spheres in contact that gives perfect symmetry as a fixed condition throughout for a group of an indefinite number is the cubical system, and this does not give maximum density: while the only possible arrangement that gives maximum density as a fixed condition throughout such a group is the rhombic dodecahedral, but this does not give universal symmetry. *There is no arrangement possible giving both maximum density and universal symmetry.*

It is scarcely necessary to add that these relations in no manner depend on absolute dimensions—they are true for spheres of the

minutest diameter conceivable as well as for those of the most colossal size we can imagine, and for all intermediate sizes.

Now regard the spheres as equal masses of homogeneous matter endowed with the property of mutual attraction or gravity. They will tend to collect together in a group if free to move relatively, and to remain so. The cubical arrangement would be entirely consistent with complete equilibrium of the attracting forces, but this can not be permanent since it is not a formation of maximum density or concentration. It does not fully satisfy the collecting tendency under the forces of mutual attraction, and the equilibrium of the cubical formation must be unstable. If arranged on the cubical system the group will collapse on the slightest disturbance and the members will seek another arrangement permitting greater concentration. The rhombic dodecahedral grouping affords maximum concentration but it too fails to give complete stability, for it is not perfectly symmetrical and the forces of attraction can not be permanently balanced or in complete equilibrium throughout. Any one group of thirteen of the balls or spheres would be "satisfied" as to concentration and balance or equilibrium by the regular dodecahedral arrangement, but as above set forth this could not possibly obtain as a fixed condition throughout a group of more than thirteen of the spherical bodies. For a group of an indefinite number of the equal spheres greater than thirteen, *there is no stable and permanent arangement possible.*

We can now in imagination expand the diameter of the balls to any extent limited only by infinity—which means without limit—and likewise their size may be reduced to any dimensions short of zero, while their number may be multiplied also without restriction. The above relations are true for the smallest units of matter that can exist as well as for the most gigantic bodies. Furthermore the truth of these principles is not dependent on the complete *occupation by matter* of each of the individual spherical spaces or volumes considered. These spherical spaces may be only the respective "fields" or space loci of one or more separate portions of matter in a state of motion respecting neighboring portions in other similar spaces or fields—all having motions of revolution, of vibration, of oscillation, or of pulsation, with limitless combinations and variations as to size and number of the individual portions, their velocity, direction and amplitude of movement, etc.

Every assemblage or group of matter tends to assume the form with an external bounding surface of spherical shape under the mutual attractions of its parts, but however large or small such an assemblage or whatever may be the number of its individual members, its internal structure is governed by the principles above outlined. This indicates an explanation of the paradox involved in the first assumptions or impressions above referred to. The conceit that a perfectly symmetrical grouping of equal spheres with maximum concentration can be made, at first seemingly entirely simple and even axiomatic, turns out to be inconsistent with elementary facts of geometry and therefore impossible.

A direct corollary of this proposition is that a *plenum* of matter in any form, or any material "continuous medium," is impossible and non-existent. All material substances affected by gravity—which is equivalent to saying all real matter whatever—*must* be atomic or "granular" in its structure and in its behavior, and this does not depend upon an assumption of "intermolecular repulsion" or of "kinematical energy," nor indeed even upon the theory of energy as a separate entity, nor on any other extraordinary force or attribute. Plain gravitational attraction with the resultant unrelenting stress and struggle for a status which is *geometrically unattainable* is all-sufficient. This may even be made to account for apparent repulsion.

The reason for the conviction and belief that these principles have an intimate and fundamental relation to the universal and eternal unrest of matter and to all physical phenomena of whatever nature will now be apparent and we have at least an interesting and suggestive side light on Boltzmann's demonstration of "the indispensability of atom-

istics in natural philosophy," as recently referred to by Professor Bumstead.[1]

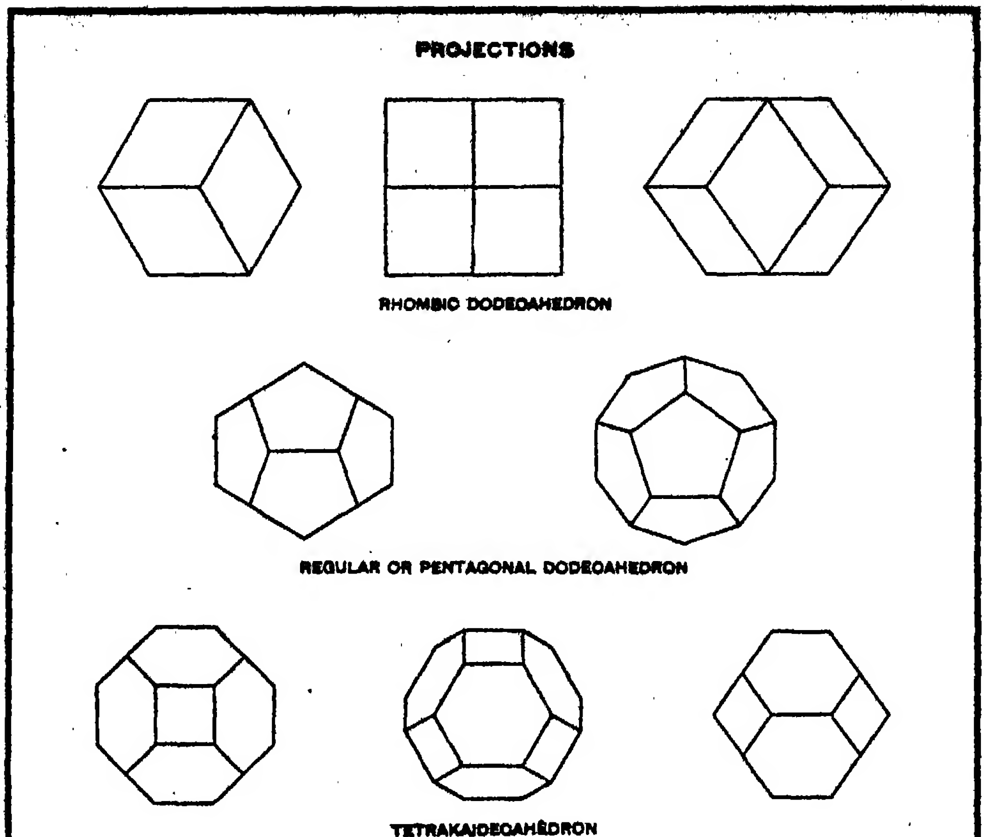
Going back to D'Arcy W. Thompson's book on "Growth and Form," there are found some exceedingly interesting discussions and references pertaining to the various possible divisions of space by plane surfaces that have a direct bearing on this subject. We can assume our equal spheres to be soap bubbles. The shape of a single bubble by itself is determined by the tendency of the enclosing film to contract due to its "tension," or the mutual attraction among its own particles, and the opposition to this contraction tendency presented by the enclosed air. By the same principles that have been explained above it can be shown that in a group of such bubbles the tendency is to assume an arrangement that will give complete symmetry and a minimum total partitioning area, that these conditions can not both obtain as a fixed and simultaneous status for the whole group, and that there can not be a condition of equilibrium and stability throughout such a group. The same will be true of any similar group of compartments or cells enclosing a fluid and with walls or partitions composed of substance that is of a fluid nature. Thompson seems to have fallen into some errors in his discussion, as where he calls the rhombic dodecahedron a "regular solid"[2] and where he understands that by means of an assemblage of equal and similar "tetrakiadecahedrons" space may be homogeneously partitioned into similar and similarly situated cells "with an economy of surface in relation to area (volume ?) even greater than in an assemblage of rhombic dodecahedra" (p. 338). The "regular" tetrakiadecahedron is a semi-regular polyhedron, a fourteen-sided volume with six equal square faces and eight that are regular and equal hexagons, the sides of these squares and hexagons all being equal. Such a solid may be formed by cutting off the corners of a cube, also by cutting off the corners of a regular octahedron. Space can not be divided into equal volumes of this shape without surplus, or in other words these volumes can not be stacked together without leaving voids. This may readily be determined by a study of the diedral angles, or practically by constructing a number of the tetrakiadecahedrons and trying it. However, these errors are not material to the present purpose, and it was Thompson's book that first suggested to the writer's mind a still broader generalization of the principles herein referred to.

It may be stated that all processes and phenomena of life are associated directly with some form of fluid substance. This includes not only gaseous matter and liquids but many forms of matter that are not solid in the ordinary sense nor yet liquid, but which have a certain degree of mobility among the constituent particles. The essential primary element of all organisms is the cell. *All* material substances whatever, whether affected by influences of life or whether only dead matter, are alike governed by the physical and mathematical laws here outlined. Is there not therefore a remarkable and intimate relation between the "simple geometrical principle" above explained and all organic existence and processes;—All life, growth, repair, decay, and dissolution:—Even all mind, intelligence, emotion, and all reasoning and thought. The speculative philosopher might indeed go so far as to add all health, satisfaction, and pleasure; all sickness, distress and pain; all relations and struggles among humans, all endeavors of man, all events of history, *everything*:—And the psychologist may here note an analogy to the unending strife between good and evil which figures in so many of man's superstitions and religious beliefs, primitive and otherwise.

A further conception of the profound significance of these elementary geometrical relations in connection with all activities and phenomena of the material universe may be formed by imaging a region or space, apart from any known real one, where it *is* possible for equal spheres to be so grouped that the arrangement will have at the same time maximum concentration and universal symmetry—an imaginary space where the regular dodeca-

[1] See Science for January 18, 1918.

[2] "Growth and Form," p. 328.



To accompany paper on "A Geometrical Basis for Physical and Organic Phenomena" by John Millis

Drawn by O. W. Robeson

hedron has each of its diedral angles exactly 120 degrees instead of 116° —33′ —54″ (or, if preferred, where the full circle is made up of about 349—2/3 real degrees instead of 360), and where equal *solids of this form* will therefore stack together without voids. The curious and interesting speculations and deductions that follow from imagining a space with more *dimensions* than real space possesses (as four dimension or *n* dimension space), or a space having special properties like "curvature," etc., are quite well known. All matter in the hypothetical space permitting the special arrangement of equal spheres as above will, if we assume gravity to remain normal, tend to concentration as in real space but this tendency will not be checked or modified or counteracted by a departure from equilibrium resulting from an approach or approximation to the rhombic dodecahedral grouping of spherical elements, since the tendency will be to assume the regular dodecahedral grouping throughout. All matter under these conditions must eventually become a stagnant and dead plenum, an amorphous and non granular mass, in which no physical activity or life could possibly have being.

Another curious paradox, not altogether devoid of usefulness, is found in the self contradictory conception, which is at least semi logical, that there could only be a "real" continuous *ether* in a space with the imaginary properties above described! There are as yet unsurmounted (and unsurmountable?) diffi-

culties in the way of attempts at such a conception for *real* space, but even in the hypothetical space a continuous ether would find obstacles to the exercise of its principal function which is "to undulate." Moreover there would be no particular object in undulating—nothing to incite undulation—and so from all angles the ether idea has a rather hard struggle for a real existence.

We deduce properties of the circle by assuming that it is possible to divide the continuously curved circumference into parts so small that each one will be a straight line, and the rigid accuracy of the results so obtained is in no degree vitiated by the fact that the assumption can not possibly be true. Likewise we may deal with physical phenomena *as though there were* a "medium," an all pervading plenum of substance, itself devoid of gravity and of most other properties of real matter saving only the capacity to undulate. We can deduce, explain and predict with entire success—with consistent results and even astonishing confirmations—notwithstanding our medium or ether may be entirely hypothetical, its assumed properties may be contradictory in themselves, and it may not be possible for such an imaginary medium to have a real objective existence.

To locate and corner the remaining major difficulty in the way of a full comprehension of things of nature will at least contribute to our plans and measures for mobilization of forces and will indicate the main objective and the methods of attack, even if the adversary shall prove forever invincible.

Body B is separated from body A by an intervening distance. It is not possible for an "impulse" of mutual influence which requires time for the passage to be in transit between A and B, to be disconnected from both for the moment—suspended between them in other words—*without any intervening medium except space?* What a flood of light and clarity would be shed on and through the accumulated mass of physical facts and data, as well as the tangled maze of speculative perplexities, if an affirmative answer to this conundrum could only be given.

No confession of individual faith can be claimed to be of itself a useful contribution to our knowledge of material things, and this is distinctly true so far as concerns the ideas of the undersigned, but as has recently been said by a distinguished physicist it is well sometimes to declare ourselves in this respect "for this naturally has its influence upon all that is said and done and to the end of making the point of view of the writer clearly understood." (Crehore) It will be advantageous for the reader if he can feel that the writer is setting forth ideas with a certain degree of self felt confidence and "intellectual rest." I will therefore add the following, which is stated partly in the first person since it is a sort of individually conceived framework or background on which to pin ideas and new facts; frequently with a satisfactory fit in place, sometimes for the moment quite detached from the general pattern, but as a rule with a constant tendency towards accordance with what may ultimately turn out to be a complete and consistent picture.

There is only one kind of real space, the kind of everyday experience.

There is no material substance that does not have the common attribute of gravity.

There is no "force" except gravity, and all physical phenomena are resolvable into this conception.

Gravity is an inherent, essential, and universal attribute of matter. It is and ever will remain inexplainable. What is more (and this is another paradox) if an "explanation" were possible this would actually be a retrograde step in the progress of knowledge, since we would then have at least one remaining mystery on our hands, almost certainly still more troublesome than is that of gravity.

There is no such real thing as a continuous medium or ether. This however in no manner or degree disparages the vast majority of the facts, results and predictions that have been accumulated and accomplished on the "as though there were" assumption regarding an ether, nor is it inconsistent with the confident belief that there will be very many additional real and useful developments and advances in

our knowledge of natural things and phenomena on the same assumption.

It will be recognized that whatever there may be of novelty in the above first principles is found in the combination rather than in any one element.

Finally I concede with the eminent philosophers of long ago that an idea of the real nature of "action at a distance" without any intervening medium is inconceivable to the human mind (*my* human mind—they no doubt likewise meant theirs) and especially so is the suggestion that an impulse which requires time for transmission from one body to another may have left the one and be on the way to the other—in a state of detachment between—with nothing but empty space along the road. (It is probable that the "velocity of light" as a physical constant is the same as the velocity of transmission of a gravitational impulse or change from one body of matter to another, or at least that there is some very direct relation beween the two.)

Here however is the parting of the ways. I have faith that it will some day be accepted that this inconceivableness is attributable, *not* to the fact that the suggestion is incompatible with the real workings of nature, but to the limitations in the powers of human comprehension.

If it can be accepted that "philosophy" is only a shorter term for peace of mind arrived at or approximated to after long pondering, then the above may be set down as a sort of personal philosophy of the writer's.

And the path of future progress? We are apt to regard the human intellect of our period as already in a stage of its development which may be called maturity, but this is not at all certain. If something like a curve is plotted to indicate the mental status of man at different periods or "ages"—the primitive state, the stone age, the bronze age, the age of iron, etc., its general shape will indicate whether the present is the age of finality in this respect. There was just as much reason for regarding any one of the previous ages as a culmination as there is for assuming that we are now on an ultimate crest of the curve of human powers of understanding. In fact if we consider the varying rate of change in direction of such a curve, or the rate of its departure from a base line of zero intelligence, there is less ground for thinking our present mental capacity is at a maximum than there was for such a belief at any previous age or period.

Let us therefore "play" that there *is* an ether, with all its seemingly necessary though improbable attributes, and go ahead with our observations, experiments, studies and researches until the mind of man, now possibly only in the juvenile or youthful stage of its growth, may have so far advanced towards maturity as to be able to put aside this elementary conception and to substitute something more grown up. Meanwhile let us not lose sight of this all-important coordinate part of the program for advancing—the development of the human mind in capacity for comprehension so it can assimilate and interpret the facts as they accumulate and keep pace with the general progress. The super intelligence capable of fully comprehending all nature will doubtless always remain a limiting ideal—something to be eternally striven for, to be approached all the while more nearly, but forever unattainable.

John Millis

210 Postoffice Building,
Savannah, Georgia

SCIENTIFIC EVENTS

MANGANESE ORE IN GEORGIA

As manganese is urgently needed in the war several geologists of the United States Geological Survey, Department of the Interior, have been making systematic examinations of areas that are believed to contain deposits of manganese and manganiferous ores in the United States and the West Indies, in order to appraise our available resources of manganese and to assist in stimulating its production and use.

Manganese is a metal resembling iron. It is used principally in the manufacture of steel, to which it is added in the form of alloys with iron, such as ferromanganese and spiegeleisen. It is used also in glassmaking, in many chem-

ical industries, and in the manufacture of electric batteries. There are four commercial sources of manganese—manganese ores, manganiferous iron ores, manganiferous silver ores and manganiferous residuum from roasting zinc from an ore containing zinc, iron and manganese minerals. Under normal conditions the world's supply of manganese ore has come mainly from India, Brazil and Russia, but owing to the derangement of ocean transportation and of the foreign manganese industry only the deposits of Brazil are now available to the United States, and these can not be drawn upon freely because of the scarcity of ships and the long shipment.

The deposits of manganese ore in the Cartersville district, Ga., have recently been examined by Laurence LaForge, geologist of the United States Geological Survey, Department of the Interior, in cooperation with Mr. J. P. D. Hull, assistant state geologist of Georgia, and Professor W. R. Crane, of the United States Bureau of Mines. The ore deposits occur in a belt, 1 to 3 miles wide and 18 miles long, on the east side of the Coosa Valley, at the base of and on the western slopes of the hills that form the western margin of the Piedmont Plateau. This belt is in the eastern part of Bartow county, and the city of Cartersville is on its west side near its south end A branch of the Louisville & Nashville Railroad extends along the west side of the belt and spur tracks reach several of the larger mines. Iron ore, ocher and barite are also mined in this belt, and some of the mines produce two or more of these minerals.

The result of the examination is encouraging, for, although the district is an old one, the field studies of the geologists and the exploratory work of the mining companies have revealed the existence in it of large reserves of both high-grade manganese ore and manganiferous iron ore. In recent years little manganese ore has been mined in this district, but the necessity of the war and the curtailment of imports which have stimulated the production of domestic ore have caused a revival of mining there.

The workable manganese ores occur in part in vein and replacement deposits and in part in detrital deposits. The ores in the vein and replacement deposits are believed to have been deposited from surface water that carried in solution material leached from a considerable thickness of weathered rock, or, in places, from other older deposits of the same sort. The detrital deposits are scattered through a widespread thick surficial mantle of rock waste, wash and alluvium. The deposits of both types are extremely irregular in character and occurrence. They include both hard and soft ore and both pyrolusite and psilomelane, and perhaps manganite, though pyrolusite seems to be more abundant. Both types include large bodies of manganiferous limonite.

The vein and replacement deposits are found mainly in residual clay and fragments of rock derived by weathering from a siliceous limestone, or in a breccia made up chiefly of the shattered, weathered and somewhat displaced upper beds of quartzite that lies beneath the limestone. Some, however, are found at or near the base of the thick surficial blanket of rock waste and alluvium, in which detrital ores also occur. The manganese minerals occur as coatings on or as veins filling crevices in the quartzite; as irregular veins, sheets and pockets in both residual clay and alluvial material; and as stalactitic or mammillary concretions in the clay.

The hard rock that underlies most of the vein and replacement deposits is the Weisner quartzite, which was once overlain by the limestone that has been called the Beaver limestone, both Lower Cambrian formations. Beds of siliceous dolomite still remain, but nearly everywhere the soluble material of the limestone has been removed and nothing is left to indicate its former presence but a dense lumpy dark-red clay or masses of chert fragments in a red clay matrix. The strata have been sharply folded and have been displaced by many small thrust faults, so that the resulting structure is very complex.

The high-grade ore of the Cartersville district, as shown by the average of analyses of about 1,600 tons of material shipped within the last few months, contains about 42 per

cent. of manganese, 6 per cent. of iron, 6 per cent. of silica and 0.14 to 0.20 per cent. of phosphorus. The manganiferous iron ore of the district, as shown by the average of the analyses of about 300 tons shipped recently, contains about 15 per cent. of manganese, 20 per cent. of iron, 30 per cent. of insoluble material and 0.17 per cent. of phosphorus. Practically all the ore produced in the district is shipped to furnaces at Birmingham, Ala., for the manufacture of ferromanganese, spiegeleisen and manganiferous pig iron.

The irregularity of the occurrence of the ores, the complex geologic structure, and the scarcity of outcrops in much of the district make it extremely difficult to use the geologic conditions as a guide in exploration and development and hazardous to predict the probable occurrence of ore in any locality or to do much more than to guess at the reserves of ore. Fortunately, however, the district has been worked for many years, either for manganese ore or for other minerals, and has been rather thoroughly explored, so that there is some basis for an estimate of the reserves. The statement seems to be warranted that the district probably still contains at least 100,000 tons of minable high-grade manganese ore and perhaps 250,000 to 300,000 tons of manganiferous iron ore—sufficient to last for many years unless the rate of production is greatly increased.

BRITISH ELECTRICAL INDUSTRIES AFTER THE WAR

In the general survey with which the report of the British Departmental Committee on the electrical trades is introduced, it is urged, as we learn from the *Journal* of the Society of Arts, that the national importance of those trades has never been realized either by the government or the general public. Through the achievements of Faraday, Wheatstone, Kelvin, Swan, Hopkinson, and many others, Great Britain was first in electrical enterprise, and should have retained her preeminence; but manufacturers were hampered while Parliament and local authorities debated how the distribution and use of electricity might be prevented from infringing "conventional conceptions of public privileges and vested interests." Consequently foreign manufacturers were enabled, both in their own and other markets to gain a hold which they have never lost. The approximate annual value before the war of the total products of electrical plant, mains, and appliances in this country and Germany is set out in the following table:

	Great Britain. £	Germany. £
Total electrical products.	22,500,000	60,000,000
Exports	7,500,000	15,000,000
Imports	2,933,000	631,000
Consumption of home-made machinery	15,000,000	45,000,000

Moreover, of the £22,500,000 manufactured here, a large proportion was produced by concerns under foreign control, and in the case of "British" exports a proportion consisted of foreign manufactures reshipped as British goods! Apart from legislative obstacles, Great Britain, it must be remembered, had attained much prosperity and technical efficiency in her use of steam, and therefore her manufacturers had less inducement than their rivals in foreign countries to adopt electrical driving. Another factor retarding our electrical progress has been the "strength of the gas interests." Again, foreign governments, appreciating the importance of conserving their home markets as a basis for the development of overseas trade, imposed protective duties and exerted influence on State Departments to purchase native goods. An industry cultivated under these and other encouraging conditions has had an immense advantage in international competition. There is, the committee says, conclusive evidence of the existence of German control over companies ostensibly British, and of that German control being exercised to the detriment of British interests indirectly through companies incorporated in America, Switzerland, and other neutral countries. "At the outbreak of war negotiations were in progress for the acquisition by Germany of financial control in existing companies of the United Kingdom, as well as in the British Dominions and India,

which if successfully concluded would have still further restricted the use of British goods in many parts of the empire."

The scientific replanning of our distribution of energy on which the committee so strongly insists would, it is calculated, effect a saving of no less than 50 million tons of coal per annum. Witnesses of high authority estimate the loss incurred by the nation through failure to take full advantage of electrical progress at quite £100,000,000 a year.

The larger part of the report is devoted to a careful and detailed examination, from sectional points of view, of the position of the industry. Section I. deals with electricity generation and transmission; Section II. with electrical traction; Section III. with manufacturing; Section IV. with the interdependence of manufacture and finance; and Section V. with imperial control of sources of electrical energy. Respecting the latter, it is suggested that, in particular, India and the self-governing Dominions should take stock of their facilities for generating electricity, whether from water-power, coal, oil, or other sources of energy, and should appreciate their permanent and ever-increasing importance to the empire.

THE DEPARTMENT OF CHEMISTRY OF THE COLLEGE OF THE CITY OF NEW YORK

The following members of the staff of the department of chemistry have gone into war work:

1. In the service:
   - Captain Reston Stevenson, Sanitary Corps, Overseas.
   - Major F. E. Breithut, Chief Personnel Officer, Chemical Warfare Service.
   - Second Lieutenant Paul Gross, Research Division, Chemical Warfare Service.
   - Captain D. L. Williams, chief of supplies, Research Division, Chemical Warfare Service.
   - Second Lieutenant Martin Meyer, United States Army.
   - Corporal Howard Adler, Chemical Warfare Service.
   - Corporal Arthur W. Davidson, Chemical Warfare Service.
   - Ensign Benjamin Rayved, Paymaster Division.
   - Private Leon J. Smolen.
   - Private Nathan Rauch, Chemical Warfare Service.
   - Private Moses Chertcoff, Chemical Warfare Service.
   - Private F. L. Weber, Students' Army Training Corps.
   - Private Martin Kilpatrick, Chemical Warfare Service.
   - Private Hyman Storch, Chemical Warfare Service.
   - Joseph L. Guinane, Chemical Warfare Service.
   - Private Samuel Yachnowitz.
   - Yeoman Julius Leonard.
   - Yeoman Alexander Lehrman, Chemical Division.
2. In civilian capacity:
   - Professor H. R. Moody, War Industries Board.
   - Tutor B. G. Feinberg, Ordnance.
   - Fellow Paul Scherer, Ordnance.

The present staff is as follows:

Baskerville, Charles, professor and director of the Chemistry Building, emeritus.

Friedburg, L. H., associate professor of chemistry.

Curtman, Louis J., assistant professor, chief of the Division of Qualitative Chemistry.

Prager, William L., assistant professor, chief of the Division of Organic Chemistry.

Curtis, Robert W., assistant professor, chief of the Division of Quantitative Chemistry.

Estabrooke, William L., assistant professor, chief of the Division of the Evening and Summer Sessions.

Coles, Henry T., assistant professor of industrial chemistry.

Cooper, Herman C., assistant professor of physical chemistry.

McCrosky, Carl R., instructor.

LeCompte, T. R., instructor.

Brown, Stanley F., tutor.

Meltzner, Max, tutor.

Babor, Joseph A., tutor.

THE CHEMICAL WARFARE SERVICE

The Chemical Warfare Service has been duly authorized by order of the Secretary of War, to make the necessary arrangements through the Adjutant General's Office to secure the furlough, without pay or allowances, of such chemists as are necessary in such government bureaus as the Bureau of Standards, Bureau of Chemistry, Bureau of Mines, United States Patent Office, where such chem-

ists are engaged in chemical work for the government, or state bureaus concerned, essential to the prosecution of the war. At the same time they are advised that the new selective service regulations, to be published shortly, will emphasize to the draft boards the fact that skilled employees of war industries should be placed in deferred classification. The induction into the military service of skilled men necessary to essential industries or occupations, to be subsequently furloughed back to their industries or occupations, involves an expense to the government, and the men concerned lose time from their necessary work. The bureaus concerned are authorized by the selective service regulations to submit to the draft boards affidavits and written proof to maintain their contention that their employees should be placed in deferred classification and it is believed that they should be encouraged in securing deferred classification rather than securing the furlough of the men after they have been inducted into the military service. All communications in regard to information from those desiring any details should be addressed to Major Victor Lenher, Chemical Warfare Service, U. S. A., chief, governmental and State Relations Branch, Unit F, Corridor 3, Floor 3, 7th and B Streets, N.W., Washington, D. C.

THE AMERICAN COLLEGE OF SURGEONS

The American College of Surgeons will convene at the Waldorf-Astoria Hotel, New York City on October 21. Arrangements for the meeting, which is expected to attract surgeons from all parts of the United States and Canada, are in charge of a committee headed by Dr. J. Bentley Squier. Three important meetings at which the latest discoveries in medical science will be discussed and demonstrated will be held on October 22, 23 and 24.

The first will be addressed by the retiring president, Dr. John G. Clark, of Philadelphia, after which Dr. William J. Mayo, of Rochester, Minn., president-elect, will be inducted into office. Other speakers at this meeting will be Surgeon-General Gorgas, of the army, Surgeon-General Braisted, of the navy, and Surgeon-General Victor Blue, of the public health service. Clinics will feature the remaining sessions.

Among the surgeons expected from abroad are Sir Thomas Myles, C.B., of Dublin; Gray Turner, of Newcastle-on-Tyne; Raffaele Bastianelli, of Italy; Major R. Ledeaux Lebard, of the French army; Theodore Tuffler, Surgeon-General of the French army; Lieutenant Colonel Clarence L. Starr, of Toronto; Sir Robert Jones, of Liverpool; W. W. Chipman, of Montreal; Pierre Duvall, of Paris; Surgeon-General Antoine de Page, of the Belgian army, and Colonel Cuthbert Wallace, of the British army.

Prominent American surgeons who are expected to attend are Major-General M. W. Ireland; Surgeon-General Blue, of the public health service; Major General Gorgas, of the army; Surgeon-General Braisted, of the navy; Colonel Frank Billings and Colonel Joseph Miller, of the Army Medical Corps, and Dr. Frank Martin, founder of the American College of Surgeons. An invitation has also been sent to Colonel Joseph A. Blake and Colonel George E. Brewer, New York surgeons, now with the forces in France.

THE AMERICAN AGRICULTURAL COMMITTEE

The United States Department of Agriculture announces the arrival in England of a committee of men familiar with food production and agricultural organization and activities in the United States. The personnel of the committee is as follows:

Dr. W. O. Thompson, chairman, president of Ohio State University, Columbus, Ohio; Mr. Carl Vrooman, Assistant Secretary of Agriculture; Mr. R. A. Pearson, president of Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa; Mr. T. F. Hunt, director of the Agricultural Experiment Station and dean of the College of Agriculture, University of California, Berkeley, Cal.; Mr. D. R. Coker, farmer and member of National Agricultural Advisory Committee, Hartsville, S. C.; Mr. Wm. A. Taylor, chief, Bureau of Plant Industry, U. S. Department of Agriculture; Mr. George M. Rommel, chief,

Animal Husbandry Division, Bureau of Animal Industry, U. S. Department of Agriculture; Mr. George R. Argo, specialist in cotton business methods, Bureau of Markets, U. S. Department of Agriculture; Mr. John F. Wilmeth, administrative assistant, Bureau of Markets, U. S. Department of Agriculture.

The committee will secure general information regarding food production conditions in England, France and Italy, so that, when they return, they will be able to reveal the needs more effectively to the leaders of agriculture in the United States and to farmers generally. They will also study agricultural problems in England, France and Italy, including the use of machinery and the assignment of labor in farming operations, the livestock situation, the depletion of herds and the probable extent to which Europe may call on this country for live stock to replenish herds, the seed situation and the probabilities of securing supplies from Europe and similar matters.

SCIENTIFIC NOTES AND NEWS

Major General Merritte W. Ireland, of the Medical Corps, has been appointed Surgeon General of the Army, to succeed Major William C. Gorgas, who was retired on October 5. General Gorgas will remain in Europe as the medical representative of the United States Army at the Interallied War Council.

Dr. Arthur L. Day, director of the Geophysical Laboratory of the Carnegie Institution of Washington since its establishment in 1906, has resigned to accept a research position with the Corning Glass Works, Corning, N. Y.

Secretary Houston has visited the drought-strickened sections of the country to confer with field representatives of the Department of Agriculture in regard to making loans to farmers from the special fund of $5,000,000 set aside for that purpose. Professor G. I. Christie and Mr. L. M. Estabrook, assistants to the Secretary, are supervising the work in the northwest and southwest, respectively.

Professor Frank P. Underhill, of Yale University, has received the commission of Lieutenant Colonel in the Chemical Warfare Service. He is in charge of gas investigations at New Haven.

William H. Ross, of the Bureau of Soils, has been commissioned captain in the Chemical Warfare Service and has been assigned to work in the chemical laboratory, at Edgewood Arsenal in Maryland.

Dr. Lucius Polk Brown, chief of the Bureau of Food and Drugs of the New York City Health Department, has been granted leave of absence without salary for the period of the war, to accept a commission as a captain in the food and nutrition division of the sanitary corps.

Dr. Paul E. Klopsteg, formerly of the physics department of the University of Minnesota, is now with the Leeds and Northrup Company, of Philadelphia.

The Italian Scientific Society has awarded the natural sciences gold medal for 1918 to Professor Filippo Eredia for his work in meteorology.

In honor of Professor Golgi, who retires this year from the chair of pathology and histology at the University of Pavia, it is proposed to found a scholarship in the medical department for the orphan of some physician, preferably one whose father was lost during the present war. Contributions may be sent to the treasurer, Tesoriere dell' Ordine dei Medici della Provincia di Pavia.

Mr. William Bowie has resigned as treasurer of the Washington Academy of Sciences on account of having been commissioned a major in the Engineering Corps, U. S. A., and is succeeded by Mr. R. L. Faris, of the Coast and Geodetic Survey.

Mr. Geo. F. Freeman, plant breeder in the college of agriculture of the University of Arizona, has left for Egypt and will take up his permanent residence in Cairo, in connection with the Société Sultanienne de Agriculture.

The first lecture of the series of the Harvey Society will be given in New York City on Oc-

tober 19, at 8.30 P.M., by Dr. E. K. Dunham, on "Certain aspects of the application of antiseptics in military practise."

PROFESSOR EDWARD F. NORTHRUP, of Princeton University, addressed the meeting of the Institute of Radio Engineers on October 9, on the subject "Special heating effects of radio frequency currents."

DR. CHARLES R. EASTMAN, of the American Museum of Natural History, the author of important contributions to paleichthyology, was drowned at Long Beach on September 27.

BY the will of Alfred Louis Moreau Gottschalk, American Consul General at Rio de Janeiro, Brazil, who was one of the passengers on the United States collier *Cyclops*, which mysteriously disappeared from the seas last March, the U. S. National Museum receives a valuable collection of Inca pottery, Aztec idols, Trojan lamps, eastern brasses and arms, pottery and porcelains from Spanish America.

BRAZIL is sending a medical mission to France. The party is to consist of fifty doctors besides a number of students. They are to be attached to the Brazilian Hospital already installed near the front.

TWELVE professors chosen from the faculties of various Spanish universities spent August in Paris, visiting the principal medical and surgical centers. The mission was charged to prepare a report on the progress made by French war surgery.

THE much-dreaded European potato wart disease for which the Federal Horticultural Board quarantined against further importation of potatoes in September, 1912, has been discovered in ten mining villages near Hazleton, Pa., by Professor J. G. Sanders, economic zoologist of that state. Every effort of the state authorities, with the federal department assisting, is being directed to prevent the further spread of this insidious and most dangerous disease known to affect the potato. It appears that the disease has been established in some of these villages for at least seven or eight years, where it has been impossible to secure even the amount of seed planted in some gardens for the past few years. Only by accident was this disease discovered in these villages, which are largely made up of foreigners, who supposed that there was something affecting the soil and ruining the crop. It seems advisable that all state authorities should inspect large centers of consumption where imported potatoes may have been purchased during the past eight or ten years.

THE British Ministry of Munitions has made an order prohibiting the sale, except under licence, of radio-active substances, luminous bodies and ores. The order applies to all radio-active substances (including actinium, radium, uranium, thorium and their disintegration products and compounds), luminous bodies in the preparation of which any radio-active substance is used, and ores from which any radio-active substance is obtainable, except uranium nitrate and except radio-active substances at the date of the order forming an integral part of an instrument, including instruments of precision or for timekeeping.

MR. J. E. BARNARD, speaking at the British Scientific Products Exhibition at King's College on August 20, said that the microscope was the almost universal tool of scientists, and was used in every industry which had a technical side. There was little doubt that after the war the microscope industry would undergo a transformation that would lead to a state of affairs in which the British microscope would be preeminent, as indeed, it was somewhere about 1880 to 1890.

SOME of the results of research on the nitrogen problem were shown at the British Scientific Products Exhibition at King's College, London. The Munitions Inventions Department of the Ministry of Munitions exhibited a unit plant for the oxidation of ammonia to oxides of nitrogen. The process (which was not extensively used outside Germany before the war) has been largely used by the enemy to obtain nitric acid for explosives, and also in the manufacture of sulphuric acid by the chamber process as a substitute for Chile nitrate, which he has been unable to obtain owing to the blockade. The method is now widely used in England, and large firms,

such as Messrs. Brunner, Mond, and Co. (Limited), and the United Alkali Company (Limited), are using apparatus similar to that exhibited. The program of lectures at the exhibition was as follows: Professor A. Keith, F.R.S., "Scientific progress as applied to medicine." Dr. F. M. Perkin, "Oils from mineral sources." Mr. R. E. Dennett, "Palm tree to margarine factory." Mr. A. Newlands, "Water power in industry." Dr. C. H. Browning, "Advances in bacteriology in peace and war" (lantern lecture).

The Electrical Review, London, states that the results of the first two thrashings of electrified corn are announced by Mr. H. H. Dunn, seed specialist, of Salisbury. In the *Daily Mail* last July it was stated that over 2,000 acres were then under electrified seed. The electrification consists of soaking the seed in a weak solution of common salt or calcium chloride, passing a comparatively small electric current through the grain in soak for a few hours, and then slowly drying it in a kiln. Wheat grown at Fort St. Cleer, Liskeard, Cornwall, showed 28 per cent. increase on grain and 40 per cent. on straw. Oats grown at Moreton, near Dorchester, showed a gain of 61 per cent. on grain.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of the late Elmer P. Howe, '76, whose death occurred on June 13, 1918, Yale University would receive one half of the residuary estate, its share being estimated at about $200,000. An equal amount will go to the Worcester Polytechnic Institute.

Major George W. Littlefield, of Austin, has loaned the University of Texas, of which he is a regent, $800,000. In addition to this sum he purchased the famous Wrenn private library of its Chicago owners last spring for $225,000 and has donated the collection to the university. He also gave as a gift $5,000 for fitting up a room at the university in which to place the library. The $800,000 which he has loaned to the institution is being expended in building additions to the war schools which the university is conducting for the government. These schools include automobile mechanics, radio, aviation and military aeronautics.

The Experimental Station Record states that the agricultural school and experiment station near Panama City, Panama, started in 1915, has been closed for lack of funds. Dr. B. H. A. Groth, formerly of the New Jersey Station, who has been in charge of the school and station since its establishment, has returned to this country.

The corporation of McGill University has formally approved a recommendation made by the faculty of medicine, that women should be admitted to the study of medicine provided they have completed the first and second years in arts at McGill University, have taken an arts degree from a recognized university, or are prepared to take the double course of B.A. and M.D. or B.Sc. and M.D. at McGill. Women students are now admitted also to the medical faculties of Toronto, Queen's, and the Western Universities.

Dr. William E. Kellicott, professor of biology in Goucher College and recently head of the report division of the United States Food Administration, has been appointed professor of biology and chairman of the department in the College of the City of New York.

R. V. Mitchell, professor of poultry at Delaware Colege, has been elected head of the poultry department, and director of the all northwest egg laying contest at the State College of Washington, Pullman, Washington.

Dr. V. H. Young, formerly assistant professor of botany at the State University of Iowa, who was appointed assistant pathologist in the Office of Cotton, Truck and Forage Crop Disease Investigations of the U. S. Bureau of Plant Industry at the close of the last school year, has now resigned from this position to become professor of botany and head of the department of botany at the University of Idaho.

DISCUSSION AND CORRESPONDENCE

ERRONEOUS GENERIC DETERMINATIONS OF BEES

THE history of almost any considerable group will show that a subgenus is only a suppressed genus. In an introduction to Wilson's "American Ornithology," 1852, T. M. Brewer makes the following statement which gives an anachronistic setting to recent protests:

I have also judged it inexpedient to imitate the needless subdivisions into genera, which is the prevailing fault in modern ornithology. Without entering into a discussion of this controverted question, I have only to urge, in defense of my adhesion except in such instances as it appeared to be wrong to do so, to old genera—my conviction that the present mode of subdivision, instead of tending to simplify science, as its advocates assert, but adds to the difficulties of the beginner, and serves to discourage his efforts to master the subject.

In a synopsis at the end of this work, for example, all of the hawks and eagles are referred to *Falco* and the owls to *Strix*. The subgenera mentioned there are now recognized as genera and some of them have been subdivided into genera.

Primitive people, ignorant and stupid people, old fogies and beginners prefer large genera. But of all the people who use language the taxonomists known as "lumpers" are the only ones ever known to object to the formation of categories. A new genus is like vice, "a monster of so frightful mein." It is first an "alleged genus," then a subgenus, then a genus. In a large genus, if you can distinguish a group of species by any distinct characters, name the group. If you only point out the characters, some one else will name your group for you. In 1802 Kirby subdivided the bees into *Apis* and *Melitta*, but he separated them into many groups, not named but designated by signs. In the same year, and later, Latreille named many genera which were practically identical with the groups distinguished by Kirby. Since that time students of bees have been slow to take Kirby as a warning and Latreille as an example.

Confusion regarding genera results from the efforts of conservatives to force the conceptions associated with the theory of special creation upon those who accept the scientific theory of evolution. Under the former view genera were originally distinct. Under the latter view they were originally connected by transitional forms. The most distinct genera occur in old groups which have been broken into widely separated fragments by a process of extinction which has destroyed most of the original forms. The transitional form may be one of several things, but suppression of a genus on account of it usually involves an argument based on exceptions. If two genera containing many species could be separated all over the world, the lumpers would suppress one of them on account of a transitional form in *Ogygia*. The absurdity of suppressing groups on account of transitional forms is shown in the case of large and plastic assemblages where the more categories are needed the more they are suppressed.

Generic determinations should be made by comparing each species with the type of the genus. If a species differs in structure from this type, the determination is probably erroneous. A species may be referred to a given genus on account of its resemblance to the type or in spite of its differences. Often the type of the genus has never been ascertained and determinations are made by comparing with species which have been referred to it without any careful examination.

As a criterion for erroneous generic determinations, about all that can be done is to base inferences upon what the history of nomenclature shows. Accordingly we may take it for granted that genera will be subdivided in the future as in the past. Large genera in orders which have been neglected will be subdivided so that they will contain as many species as in orders which have been more thoroughly studied.

Smith's catalogue of the insects of New Jersey, the catalogue of the hymenoptera of Connecticut, local insects taken on flowers and the entomophilous flowers on which they were taken show the following averages of the spe-

cies for each genus. The genera of bees given in the New Jersey and Connecticut lists are those recognized by Viereck, but his views correspond with, and were probably somewhat determined by those of Cockerell, Crawford, Swenk, Sladen, Lovell and Ellis. While these authors might have different views in a few cases, the difference would hardly affect the averages.

	Species	Genera	Average
New Jersey, 1910:			
Hemiptera	504	205	2.4
Lepidoptera	2,120	715	2.9
Coleoptera	3,092	1,079	2.8
Diptera	1,661	542	3.0
Non-aculeate Hym	1,078	408	2.6
Lower Aculeata	452	99	4.5
Total	8,907	3,048	2.6
Bees	250	34	7.3
Genera suppressed		18	4.8
Connecticut, 1916:			
Non-aculeate Hym	1,819	481	3.7
Lower Aculeata	361	118	3.0
Total	2,180	599	3.6
Bees	231	35	6.6
Genera suppressed		31	3.5
Carlinville:			
Hemiptera	21	18	1.1
Lepidoptera	95	71	1.3
Coleoptera	137	82	1.6
Plants	437	261	1.6
Diptera	403	234	1.7
Non-aculeate Hym	126	74	1.7
Lower Aculeata	209	84	2.4
Total	1,428	824	1.7
Bees, R., 1918	296	98	3.0
Ashmead, 1899	296	50	5.9
Cockerell, 1918	296	45	6.5
Cresson, 1887	296	38	7.7
Dalla Torre, 1896	296	32	9.2

The table shows that, as regards genera, the lower aculeate hymenoptera and the bees have been neglected. Even 98 genera are conservative. On the analogy of the 1,428 species of other groups the 296 local bees should be referred to about 174 genera. The 250 New Jersey bees ought to be referred to about 96 genera, and the 231 Connecticut bees to 88 genera.

From the table we may presume also that when the number of species to the genus averages more than 1.7 for a locality like Carlinville, or more than 2.6 for a region like New Jersey, the generic determinations are erroneous. The table also establishes the presumption that the genera of bees suppressed in the New Jersey and Connecticut lists were suppressed erroneously. If the genera mentioned and suppressed in the two lists were used the average would be 4.8 for New Jersey and 3.5 for Connecticut.

To avoid the conclusion that these generic determinations are erroneous it is necessary to show that the genera in the other groups are not correctly determined, or that the bees differ from all of the other groups in a lack of characters on which generic distinctions can be based.

CHARLES ROBERTSON

CARLINVILLE, ILLINOIS

THE NECESSITY FOR BETTER BOOK AND NEWSPAPER MANUFACTURE WITH RESPECT TO MATERIALS USED

OWING to the effects of the present war many of our productions have suffered greatly in quality. Manufactures of all kinds that, five years ago, were as fine in all particulars as the world has ever seen turned out anywhere, have now depreciated to such an extent, in proportions and quality, that one would hardly believe, without due comparison, what an enormous falling off there has been in many instances. It has affected the output of nearly every one of our best industries, with possibly the exception of the manufacture of war munitions, war materials, and some others too well known to mention. There are thousands of newspapers published in this country. Some of the wealthier ones do not seem to have suffered much, while in the case of the majority of the smaller sheets, they have not only shrunk in the matter of their size and number of pages, but the materials used in their manufacture, notably the paper and ink, are so poor in quality that the paper, in an incredibly short space of time, becomes more or less brittle, yellow, and blotchy, all of which are but premonitory symptoms of a crumbling away—a condition that proceeds

pari passu with a fading of the ink used in printing which was, initially, of a very indifferent quality in all respects.

Now, if we take the best newspapers of the country as a whole, it goes without saying that they do and will carry the great bulk of reliable contemporary history of this war. They obtain their war news direct from a dozen or more of the very best and most reliable sources; and while they may make errors on any particular day with respect to such news, those errors are invariably corrected, in the same media, usually within short periods afterwards.

A surprisingly large number of our newspapers are now printed on the very worst paper imaginable and with inks that fade and blunt the type. All this makes for the prompt and permanent destruction of current history, and especially of the military history of the war.

So much for the newspapers; but that is not the worst of it, for what applies to newspapers is equally pertinent with respect to book and current literature generally. Books of the greatest possible value representing the literature of every department of science and research, of history and current fiction, and many other lines, are now being printed with blunt type on the most perishable kinds of wood paper, and bound in such ways that they go to pieces in an incredibly short space of time. This stricture not only applies to what is being done along such lines in this country, but likewise by most of the nations that are doing any publishing in Europe.

In other words, we are not making books on standard or any other kind of literature nearly as good, in so far as their lasting qualities are concerned, as they did in the fourteenth and fifteenth centuries. This fact I recently touched upon in an article I published in the *Medical Review of Reviews* of New York City, on the "Incunabula in the Library of the Army Medical Museum of the Surgeon General's Office." Few studies in books are more interesting than to make such comparisons as these; take some of the best volumes for instance published in 1450 and compare them with any of the best works in contemporary science and mark the difference.

It is truly marvelous to note the general quality of the work they put out in those early days—now nearly five hundred years ago. To be sure the illustrations are generally crude, while the binding, paper and printing are far and away ahead of fully fifty per cent. of the same kind of output of the present time.

No one of my present acquaintance is more familiar with all these matters than Mr. Felix Neumann, of the Library of the Surgeon General's Office, and he has, a few days ago, been so good as to submit me the following notes on the subject which have never been used in any other connection heretofore. Mr. Neumann points out that:

Periodicals and newspapers, the latter very important sources of contemporary history, are printed on such poor paper that it is very doubtful how long they will last and how long they can be preserved in libraries. In some libraries they are kept, as a matter of protection, in an entirely dry room and not loaned for use in private residences. As these periodicals and newspapers are of the greatest importance, it is desirable that those copies to be deposited in libraries should be printed on special and more durable paper. In England, for instance, there exists a law issued in the seventeenth century that the copies designated for the library of the king and for the libraries of Cambridge and Oxford, should be printed "on the best and largest paper."

An indifferent paper had already been in use at different periods. For instance, in the first half of the seventeenth century, during the Thirty Years War, the durability was not to be blamed so much as the poor quality of the paper. Many of the books printed during this period were printed on a brown paper. Such matters became still worse in the seventies of the last century, at which time many publications were printed on paper made from wood-pulp which at that time came into vogue. In consequence of this indifferent manufacture many books and bound volumes of scientific periodicals had to be reprinted by an anastatic process, as the originals had fallen to pieces.

The deterioration of printed paper of poor quality depends greatly on the influence exerted by light and heat, although paper of better quality suffers sometimes from the same reasons. Taking all this into consideration, it is advisable that the government should supervise the examination of all

paper, or that the Bureau of Standards should serve to the same end. Our technical institutions and colleges should also pay more attention to the manufacturing of paper and should add to their curriculum the manufacture of paper and lectures on the paper industry.

But far more important is it that publishers and libraries and learned institutions should work together in such matters to the end that all publications, books as well as periodicals, to be used and preserved by such institutions, should be printed on paper of good lasting quality. Such publications must have printed on their title-pages the words, "For Library Use." To be sure, publishers will charge more for such copies than for the ordinary ones. The libraries and learned institutions will gladly agree to this. The same would apply to certain newspapers.

I must believe that what has been pointed out above will be sufficient to invite attention to this most important question; and as the space in these columns is of unusual value its consideration will not be further touched at this time.

ROBERT WILSON SHUFELDT

ARMY MEDICAL MUSEUM

THE CANONS OF COMPARATIVE ANATOMY

IN the discussion in this journal[1] of the so-called canons of comparative antaomy as illustrated in the vessels of angiosperms and *Gnetales*, Professor E. C. Jeffrey employs his canons (!) in the familiar methods of the believers in *schrecklichkeit*. As such methods in any field of activity have very little effect on the real issues, the writer declines to be drawn into tempting retaliations or into discussions of unnecessary side issues apparently intended as diversions, but proposes to end the matter, so far as he is concerned, with a simple summary of the facts and the conclusions which have been drawn from them on both sides.

1. Two of the canons (recapitulation and conservatism in certain regions) are beautifully illustrated in connection with the vessels in question. In regard to this statement Professor Jeffrey and I are in entire agreement.

[1] SCIENCE, N. S., Vol. XLVII., Nos. 1214, 1221 and 1231.

2. The porous perforation of the vessel of *Gnetum* has been evolved by the enlargement and coalescence of circular, haphazardly-arranged perforations (*Ephedra* type) which are themselves in turn derived from typical bordered pits. In regard to this statement also Professor Jeffrey and I are apparently in entire agreement; at any rate our disagreement is not based on it.

3. The similar porous perforation of the vessel of higher angiosperms has been evolved by the disappearance of the bars from the perforations of the scalariform type found in lower angiosperms. With this statement Professor Jeffrey was in entire agreement when his very recent and excellent book "The Anatomy of Woody Plants" was written. On page 379 of that work he wrote, "The vessel with the porous type of perforation is clearly derived, as has been demonstrated in an earlier chapter, from the scalariform condition." (See also pages 101 and 102.) In his latest contribution to this discussion he states, however, that in some cases it originates as described in statement (2) for *Gnetum*. Nevertheless, inasmuch as he gives no instances of this phenomenon in angiosperms, and does not even mention it in his book, we may conclude that statement (3), which is merely another way of expressing his own quoted statement, is essentially correct.

4. From (2) and (3) it follows that the porous vessels of angiosperms and *Gnetales*, though similar, have been evolved in entirely different ways and therefore have no genetic connection. They can not, therefore, be used as evidence of relationship between these two great groups of plants. From this statement Professor Jeffrey dissents, apparently believing that it is not a legitimate inference from the given premises. To the writer it appears to be the only logical inference.

W. P. THOMPSON

QUOTATIONS

THE COORDINATION OF SCIENTIFIC PUBLICATION IN GREAT BRITAIN

THE Faraday Society arranged a meeting to consider the "Coordination of Scientific Pub-

lication" on May 7 last. The discussion was opened by Sir Robert Hadfield, President of the Society and a member of the Subcommittee appointed by the Conjoint Board of Scientific Societies to deal with the "Overlapping between Scientific Societies." Among others who spoke were Professor Schuster, Dr. R. Mond, Mr. Longridge (president of the Institute of Mechanical Engineers) and Mr. Wordingham (president of the Institute of Electrical Engineers). Sir Robert Hadfield's chief suggestion was that there should be a Central Board (such as the Conjoint Board) appointed to receive all scientific papers and to allot them for reading and discussion to the society to which they would be of most interest. In addition the board should circularize other societies likely to be interested in order that their members might be aware of what had been done and enabled to attend and take part in the discussion if they so desired. This plan would, of course, involve some degree of federation between all the larger societies; a federation which was evidently regarded very favorably by those present at the meeting. It has indeed already taken place in Germany, where a Union of Technical and Scientific Societies, with a roll of some 60,000 members, has been formed more especially to cope to the best advantage with the problems which must arise at the end of the war. In New York also the United Engineering Societies have a central building and library, provided by the generosity of Andrew Carnegie, where the several societies meet for discussions, and where they are brought into closer contact than is possible with the decentralization which obtains here. Nor should the federation be limited to the United Kingdom alone. The great societies should have Colonial representatives, particularly those dealing with problems of an industrial character. In pre-war days the Iron and Steel Institute had a representative of the German Empire, which was thus kept in touch with English research, but no representative from our own Dominions. With a federation of this kind it might be possible to maintain a common building (*e. g.*, an enlarged Burlington House) for meetings and to house a joint library which should contain, in particular, all the publications referred to in the International Catalogue. Several speakers dilated on this idea, Dr. Mond suggesting that it should have a staff of translators competent to provide complete translations of papers written in the more difficult languages (*e. g.*, Russian or Japanese) when they were required; while Mr. Longridge went further in desiring a College of Librarians; men able to discuss research with inquirers and not merely to put them on the track of past work, but also to inform them of the work then in actual progress! Less utopian was the demand for uniformity in publication. It is most desirable that all Proceedings, Transactions, etc., should be printed on the same sized paper and in the same type so that collected papers on any one subject may be bound together. The scheme for the pooling of papers was opposed by the institutions on the ground that they awarded prizes for the best papers submitted to them and that, under the scheme, this incentive to research might disappear. Obviously, however, this difficulty might easily be overcome if each society retained the right to print any papers sent to them irrespective of their ultimate fate at the hands of the board. A more serious objection is that a paper is usually written for a particular class of reader. A treatment suitable for the Physical Society would probably not be best for the Iron and Steel Institute. Having regard to this fact it seems probable that a central board would find its most important function in issuing a weekly or monthly list of forthcoming papers with intelligible abstracts, as suggested by Professor Schuster.—*Science Progress.*

SCIENTIFIC BOOKS

Dynamic Psychology. By ROBERT SESSIONS WOODWORTH. New York, Columbia University Press. 1918. Pp. 210.

A critic in the *Nation* once remarked, "When a statement is obviously false we call it stimulating; when it has no meaning what-

ever we call it suggestive." The present reviewer has long cherished this saying as profoundly apposite, but occasionally one encounters a thinker who can be both sane and stimulating, at once clear and suggestive. That Professor Woodworth is such a thinker is perhaps more apparent than ever before in this little volume containing his Jesup lectures. Withal it has great charm of style.

Professor Woodworth's conception of dynamic psychology is that, maintaining friendly relations with both behaviorism and the introspective school, it treats experience from the causal rather than the merely descriptive point of view. Its problem is twofold, that of *drive* and that of *mechanism*; of the impelling forces behind various forms of experience and of the method by which these forces operate. From this general point of view the several lectures, after an introductory discussion of "The Modern Movement in Psychology," deal with the topics of "Native Equipment," "Acquired Equipment," "Selection and Control," "Originality" and with abnormal and social behavior.

The characteristic feature of the author's conception of mental dynamics is that the various nervous mechanisms for the performance of mental function are not apparatus waiting to be filled with energy from a few great drives or instincts; that, on the contrary, every mechanism has a drive of its own. The mere fact of its existence as an adequate mechanism means that there is a special tendency to use it. He takes issue with McDougall on this point. Special interests and aptitudes, for instance, are not, Woodworth thinks, based on nervous mechanisms that are driven solely by great general impelling forces called interest, pugnacity, and the like; the motive forces are inherent in the mechanisms themselves and are impelling interests for their own special objects.

A drive, according to him, involves the advance excitation of the final or consummatory reaction of a series: this incipient reaction sets into operation all the associated movements which tend to bring it fully about. A mechanism which thus possesses its own drive must be an innately good mechanism; thus the "interest" which impels the student of music is due to the fact that his musical mechanisms, by innate endowment, work well.

The author is thus led logically to take issue with Freud. The various creative activities which the latter refers to the redirected energy of the sex instinct as their sole driving force, have in Professor Woodworth's opinion driving forces of their own. Of "sublimation" he writes that when an intellectual interest, say, is made to supplant the sex impulse, the latter "is not drawn into service, but is resisted." It is true that a drive may enlist other mechanisms into its service, but these are "mechanisms that subserve the main tendency, whereas 'sublimation' would mean that the tendency towards a certain consummation would be made to drive mechanisms irrelevant or even contrary to itself. There seems to be really no evidence for this, and it probably is to be regarded as a distinctly wrong reading of the facts of motivation." Professor Woodworth's idea that only inherently good mechanisms possess drives of their own is also in curious contrast to the perverse view of Adler, whom he does not mention; the view, namely, that special interests are due to inferiority of the organic mechanisms involved.

It is a refreshing doctrine that makes our intellectual interests thus self-supporting and independent of the great impelling forces which we share with the lower animals. Whether it can be carried as far as the author carries it without departing from probability the reviewer is inclined to doubt. The advantage of the opposed conception, which appeals solely to the primitive drives, is that we can see a biological justification for activities thus motivated. We can understand why organisms that failed to be driven by sex, pugnacity, gregariousness, must have been eliminated in the struggle for existence; it is not easy to see why an individual who failed to exercise for its own sake a nervous mechanism for music or mathematics should have been biologically unfit. Again, as Professor Woodworth points out, although a nervous

mechanism that works well supplies its own drive, it must not work too well; there must be some stimulus of difficulty. But may it not be argued that when a person loses interest in his work because his task is too easy, his mechanism too good, the reason must be either that the consummatory reaction is not connected with one of the great biological drives, or that he is not the kind of person to whom unsolved problems, that is, mechanisms some of whose parts are still undetermined, are *ipso facto* very strong drives; one who turns always from the familiar to the new task? If he is of this type we may as well say that he is urged by the drive of curiosity, whose biological value is clear. In other words, while special talents, specially good mechanisms, may involve special readiness of their consummatory reactions to be excited, without certain general traits of the personality like energy, curiosity, pugnacity, mere excellence of a mechanism would not suffice for its prolonged and effective use. The reviewer has elsewhere pointed out the possible function of the activity attitude in connection with those intellectual tasks which are only indirectly related to the primitive drives.

Of the many other points for discussion that are suggested by these lectures, there is space to mention but one. Those of us who hold, with the author, that introspection has furnished some scientific results "with such regularity that they command general assent, and probably even the extreme behaviorists in their hearts believe them," will be interested to observe how much of the evidence for Professor Woodworth's contentions is of an introspective character. In his arguments on the nature of human motivation the appeal is constantly to introspection.

MARGARET FLOY WASHBURN

VASSAR COLLEGE

A Laboratory Outline of Neurology. By C. JUDSON HERRICK and ELIZABETH C. CROSBY. Philadelphia and London, W. B. Saunders Company. 8 vo. 120 pp.

After many years of teaching experience on the part of the senior author, C. J. Herrick and E. C. Crosby have produced an excellent laboratory outline of neurology. The outline includes directions for the dissection of the brains of elasmobranchs and of mammals. The directions for the elasmobranchs are especially acceptable for they are accompanied by some much needed and novel diagrams from the unpublished work of Norris and Hughes. In addition to a very clear and well-arranged account of the subject matter, the volume contains abundant references to the literature. The text is arranged so that it may serve for a variety of courses, seven of which are outlined in the introductory chapter. The volume is compact and well printed both as to text and illustrations.

G. H. P.

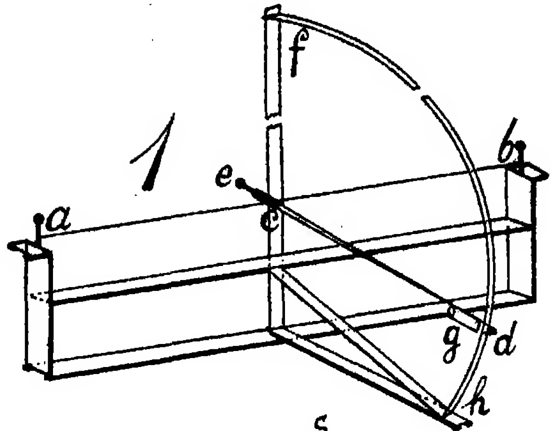
SPECIAL ARTICLES

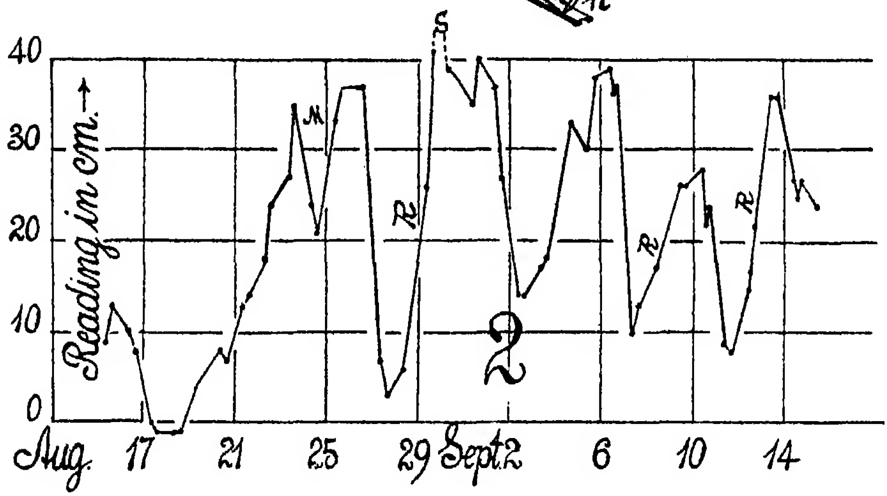
HYGROMETRY IN TERMS OF THE WEIGHT OF A FILM OF GELATINE

I HAVE recently had occassion to reconstruct a form of horizontal torsion balance which I used in 1890 in measuring the absolute viscosity of steel.[1] Even when quite robust, it can easily be made so sensitive that an excursion of over 10 cm. is equivalent to a milligram. It should therefore be available for indicating the absorption of atmospheric vapors on the part of light bodies.

Fig. 1 shows the apparatus, the suitably braced frame being made of strips of tin plate, bent C-shaped in cross section to secure rigidity. The torsion fiber, *ab*, of brass wire, .2 mm. in diameter 35 cm. long, is stretched between vertical screws (around which the end are wound), each provided with a lock nut so that a fixed tension may be imparted to the wire. The pointer, *cd*, also about 35 cm. long and of light varnished wood, is carried at the middle of the tense wire (threaded through a fine hole in the stem and looped around it), with an adjustable screw counterpoise at *e* in the rear. The index at, *d*, plays over a light circular scale of brass, *fh*, which in my apparatus comprehended about 180°, though it

[1] *Phil. Mag.*, XXIX., p. 344, 1890. The change of the electrical resistance of gelatine in relation to hygrometry has been studied by Dr. G. B. Obear.





would be much better to make it 180° from the ends of a vertical diameter. The film of gelatine (conveniently bent in form of an open cylinder and fastened with a little wax) is shown at g. The mantel contained about 3×13 sq. cm. of area and the film was less than .1 mm. thick, weighing about .4 gram.

As the observations contained in Fig. 2 are tentative, I merely chalked a centimeter scale increasing downward on the strip fg, to specify the position of the index. If absolute data were to be reached, the scale would, of course, have to be graduated in terms of $(\theta_0 - \theta)$ sec θ where θ is the variable angle measured in a given direction from the horizontal diameter of fh; or a torsion head could be provided at b. Fig. 2, in which the position of the pointer d, on successive days are laid off vertically, the curve rising as the weight of the gelatine increases, is sufficiently interesting without this and I merely placed the apparatus (without a case) in a quiet corner free from draft and read off the centimeters from across the room. It is in fact fascinating to watch it from day to day; for the play of the pointer, in spite of the handicap of leaverage, is over 40 cm. along the strip. The lowest position occurred during the relatively cool weather following August 15. After that the weight increased until the very muggy weather at M toward August 25 was passed through. With the arrival of a cold wave the weight drops almost suddenly, to increase again with equal abruptness to

herald the rain at *R*. Here the pointer, at *S*, actually gave up in despair and rested for a while on the stops; but it soon got free again and has not succumbed since, etc. The lag condition inside of the room as compared with those outside were well marked. At mid-day there is usually a slight rise of the pointer, owing to increased temperature and dryness.

So far as I can see there is no reason why such an apparatus should not be quite trustworthy. Without using mirrors, it could easily be made twenty times more sensitive. The gelatine film attached has been in the laboratory for at least twenty-five years under the same atmospheric conditions. The question is therefore pertinent whether we know as much about the continuity of thermodynamic equilibrium, or about colloids, as this simple instrument might answer.

C. BARUS

BROWN UNIVERSITY,
PROVIDENCE, R. I.

SOME ANALYSES OF THE URINE OF REPTILES

IT is generally stated that in the urine of the Sauropsida, birds and reptiles, the urea of the urine is replaced by uric acid, and that uric acid is the sole nitrogenous excretory product of importance. That uric acid is practically the sole nitrogenous constituent of the urine of a reptile of the arid regions, the horned lizard (*Phrynosoma cornutum*) of southwestern United States has been recently shown by the analyses of Weese[1] from this laboratory. Examination of the urines of some aquatic or semi-aquatic reptiles has indicated that uric acid is of less importance quantitatively in the urine of reptiles of this type than is generally assumed.

The urine was removed from the urinary bladder immediately after the death of the animal by bleeding, and analyzed promptly. The use of the newer analytical methods (colorimetric determination of uric acid and creatinine (urease determination of urea) made possible the accurate analysis of small volumes of dilute urine. The specimen of alligator urine was obtained through the courtesy of Professor Henry B. Ward, of the department of zoology. The results are expressed as milligrams per 100 c.c. urine and in the case of the turtles in percentages of total nitrogen.

	Turtle		Turtle		Alligator
	Mgs.	Per Cent.	Mgs.	Per Cent.	Mgs.
Total N	62	—	150.0	—	—
Urea N	28	45.1	46.7	31.1	29
Ammonia N	11	17.7	21.8	14.5	44
Uric acid N	12	19.1	21.0	14.0	47
Creatinine N	1	1.6	1.4	0.9	—
Creatine N	6	9.7	3.9	2.6	—

It will be noted that in both of the turtle urines examined the amounts of urea and ammonia nitrogen exceed that of uric acid nitrogen, the latter constituting only 19.3 and 14.0 per cent. respectively of the total nitrogen. In the case of the alligator urine the uric acid content was somewhat higher. The relatively high elimination of ammonia nitrogen in comparison to the amount present in most other types of vertebrate urine is of interest in suggesting that the uric acid may occur in the form of ammonia salts. The occurrence of creatinine and creatine or substances that give similar color reactions is also noteworthy. The relatively high content of creatine (or substances which react similarly on hydrolysis and subsequent treatment with picric acid and alkali) was confirmed by determinations by both the Folin-micro and S. R. Benedict methods.

HOWARD B. LEWIS

UNIVERSITY OF ILLINOIS

[1] Weese, A. O., SCIENCE, N. S., Vol. XLVI., No. 1195, p. 517, 1917.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, OCTOBER 18, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE AMERICAN CHEMIST IN WARFARE[1]

IT was the fortune of the writer in the latter part of 1916, a few months before the United States entered the war, to be sent by the Ordnance Department to study in England, France, Italy, Norway and Sweden certain chemical processes, particularly those having to do with the fixation of nitrogen.

On this trip many chemical plants were visited. In all of them the same story was told of depleted chemical personnel owing to the loss of chemists in the trenches and the consequent handicap under which all these plants were laboring in their attempts to furnish the armies with the sinews of war. The whole munitions program had been retarded owing to lack of technical men, chiefly chemists, and the statement was everywhere made that the greatest mistake that the Entente countries had made had been in giving too little attention to brain power and too much to physical strength. On the other hand, it was pointed out that Germany had carefully conserved her chemists for the development of the new and terrible forms of warfare she was forcing on mankind. Science was being used as it had never been used before, to aid a relentless power, and the only means of combating the new form of warfare was with its own weapons.

Already France, England, Italy and Canada had withdrawn all chemists remaining in the service for chemical duty at home, but many had already been lost and their loss was seriously felt. France had drawn so far as possible on the chemists and engineers of Norway, and England drew on her colonies. Indeed, the chemist who perhaps more than any other in England is responsible for the success

[1] Presented at the fifty-sixth meeting of the American Chemical Society, Cleveland, September 10, 1918.

of England's munitions program is an American; and several English chemists who were living in America returned to England for chemical duty.

With this example in mind, the director of the Bureau of Mines and the Secretary of the American Chemical Society called on the Director of the Council of National Defense, and after consulting with him, at his official request, undertook to obtain a census of American chemists for use in the war that was already imminent. This census was started in February 1917, and has been kept up uninterruptedly to the present time. By July, 1917, some 15,000 chemists had sent in full data as to their address, age, place of birth, lineage, citizenship, dependents, institutions from which graduated, chemical experience, experience in foreign countries, affiliations with technical societies, military training, publications, research work performed, and other data of importance. The list has been continually added to, questionnaires being sent to every new name of a chemist that could be obtained. While the list is not complete, owing to the fact that some chemists, no matter how carefully followed up, will not reply to letters, nevertheless, the data are comprehensive and as complete as they can be made.

The cooperation between the Bureau of Mines and the American Chemical Society was perfect. The bureau furnished its whole statistical force and the society put special clerks at work. The data obtained were indexed and cross-indexed on some 28,000 cards. When America entered the war every chemist was directed to keep the society informed as to his military status, and continual correspondence was carried on by the society direct with officers and privates in order that the chemists of the country might serve the country in the best possible manner. To-day the list consists of some 17,000 filled-out questionnaires, 12,020 membership cards of the American Chemical Society, and some 3,000 cards of *bona fide* chemists actually in war service, most of them in uniform. A card list is kept of officers and enlisted men who are graduate chemists in the United States Army in America; another list of those in France, including both those in chemical service and in the Army and expeditionary forces not yet transferred to chemical service, and another list of those in the Navy. It is believed these lists are reasonably complete and up to date.

This work has involved an expenditure of many thousands of dollars, the writing of over 10,000 personal letters, and the sending of over 50,000 circular communications to the chemists of the country.

Already in the early part of February, 1917, the president of the American Chemical Society, Dr. Julius Stieglitz, had offered without reservation the services of the members of the American Chemical Society to President Wilson in any emergency that might arise and had received an appreciative reply. On February 15, 1917, a similar communication was addressed, by direction of the president, by the secretary of the society to the Secretary of War; and on April 11, 1917, at the Kansas City meeting of the American Chemical Society, the following resolutions were passed, which were widely circulated, and had a profound effect on the mental attitude of American chemists:

Resolved, That we reaffirm the tender to the President of the United States of the services of the members of our society in all the fields in which we are qualified to act.

That the security and welfare of the country demand the organization of all the men and facilities of the United States, so as to insure the greatest possible service and value for each.

The progress of the war thus far principally teaches us that modern warfare makes extraordinary demands upon science, food supply and finance.

For the protection and success of our men under arms we recommend the use, in their respective fields, of all trained chemists, physicists and medical men, including advanced students of these subjects.

To this end, in collaboration with the United States Bureau of Mines, we are preparing a census of chemists. With no desire to avoid field service for men of training in the professions named, we urge that those of special ability be held to the work they can best perform. Thus we may avoid

unnecessary loss from lack of control of the tools and requirements of war.

We hold that the use of platinum at this time in the production of articles of ornament is contrary to public welfare. Therefore, we recommend that an appeal be made to the women of the United States to discourage the use of platinum in jewelry and that all citizens be urged to avoid its use for jewelry, for photographic paper and for any purpose whatever save in scientific research and in the making of articles for industrial need.

A committee consisting of Dr. W. H. Nichols, Dr. M. T. Bogert, Dr. A. A. Noyes, Dr. Julius Stieglitz and Dr. C. L. Parsons had, in June, 1917, drawn up and presented a report on "War Service of Chemists" and "A Plan for the Impressment of Chemists and for the Preservation of the Supply of Chemists." Several important editorials by Dr. Chas. H. Herty and communications to the chemists of the country advising them as to their procedure had appeared in *The Journal of Industrial and Engineering Chemistry.*

That the wisdom of carefully listing the chemists of the country more than warranted the expenditure and effort has been apparent from the first. The war had scarcely begun when the growth of the ordnance and other departments developed a tremendous demand for chemists, first to obtain chemical information from the other side, and soon to develop information on this side. A large part of the chemists now in war work were obtained and classified from this list. The officers of the Bureau of Mines and of the American Chemical Society were the scene of continual conferences regarding chemical personnel and the development of chemical warfare. Practically all of the chemists who early entered the Ordnance Department in a commissioned capacity were either obtained through the American Chemical Society or passed upon by its officers. When the Bureau of Mines began its investigation on gas warfare the list was invaluable, and representatives from practically all of the bureaus and departments in Washington consulted it from time to time as their needs increased.

When the chemists were later drafted into the Army this census served as a basis for determining their qualifications, which later, through the far-sighted assistance of Assistant Secretary Crowell, resulted in chemists being withheld for chemical service.

From the first the chemical personnel of the Army and Navy and the civilian bureaus was partly civilian and partly military. As the war progressed the proportion of chemists in uniform naturally increased as the men were taken from the Army and assigned to chemical duty. The question is still a disputed one—to be settled probably only when the war is over—as to whether a chemist can serve best in a civilian or a military capacity. Certainly in both capacities the demand for chemists has been unprecedented and the development of chemistry in modern warfare to those in touch with the advancement made seems almost a fairy tale.

The first requirement for chemists in quantity in Washington was in connection with gas work organized by Director Van. H. Manning and carried on by the Bureau of Mines with its own funds until July, 1917, after which, steadily increasing funds were furnished to it by the Army and Navy. The gas research work was located at the Bureau of Mines Experiment Station some four miles from the center of the city of Washington.

A branch laboratory of the Bureau of Mines was also established at the Catholic University, Washington, and other branch laboratories and cooperative research work carried on at such institutions as Johns Hopkins, Harvard, Yale, Princeton, Ohio State, Wisconsin, Washington, Kansas, Michigan, Columbia, Cornell, California, Rice Institute, Iowa State College, Bryn Mawr, Massachusetts Institute of Technology, Worcester Polytechnic, etc. Also special problems were undertaken by the National Carbon Company and the National Electric Lamp Association, as well as by chemists and laboratories of many of our other important chemical corporations.

One of the most interesting features of this work was the spirit shown by American chemists and the immediate response made by practically every chemist in America to the call to duty. The organization was rapidly built up

and contained the names of the most prominent chemists in the country, as well as those of hundreds of young chemists who will later become prominent.

When this organization was taken over by the Chemical Warfare Service in June, 1918, there were over 700 chemists at work on problems having to do with gas warfare, the design of gas masks, protection against toxic gases, development of new gases and the working out of processes for those already used, the details of incendiary bombs, smoke funnels, smoke screens, smoke grenades, colored rockets, gas projectors and flame throwers, thermal methods for combating gas poison, gases for balloons and other materials directly or indirectly connected with gas warfare.

This body of chemists reporting to Colonel G. A. Burrell had nearly 1,100 helpers in the way of clerical force, electricians, glass blowers, engineers, mechanics, photographers and laborers, so that when it became a part of the Chemical Warfare Service some 1,800 persons were transferred, of whom over 700 were chemists—among them the leaders of the profession. At the same time the gas defense operations of the Medical Department under Colonel Bradley Dewey, consisting chiefly of the large scale manufacture of gas masks and gas mask chemicals, the gas offense proving grounds under Major William S. Bacon, and the gas defense training under Major J. H. Walton were also transferred to the new Chemical Warfare Service. The story has been told in detail in the September number of *The Journal of Industrial and Engineering Chemistry* and need not be repeated here.

Shortly after this work of the Bureau of Mines was begun the development of the Ordnance and Medical Department created an additional demand for chemists. The chief of the Trench Warfare Section, Lieutenant Colonel E. J. W. Ragsdale, early called for chemists to go to England and France in a commissioned capacity to obtain necessary information. Soon other chemists were required for the planning and building of gas plants and the manufacture of chemicals. The Trench Warfare Section continued this work in greatly increasing personnel until the early part of 1918, when the chief of the newly formed Chemical Service Section was transferred to the Ordnance Department and given charge of the production of chemicals for gas warfare. A new arsenal known as Edgewood Arsenal was established for this purpose. Hundreds of chemists and engineers were employed, and the arsenal had become almost a city in size, with enormous plants ready for operation, when it too was transferred from Ordnance to the newly organized Chemical Warfare Service, in June, 1918.

It was a real epoch in the history of chemistry in warfare when, as a result of conferences held at the Bureau of Mines with officers from the Medical Corps, War College, General Staff, Navy and civilian chemists, the Chemical Service Section was established as a unit of the National Army, with Lieutenant Colonel Wm. H. Walker, formerly of Massachusetts Institute of Technology, as chief of the American branch reporting to Colonel Potter of the Gas Warfare Division, and Lieutenant Colonel R. F. Bacon as chief of the Chemical Service Section in France reporting to Colonel A. A. Fries, head of the Gas Warfare Division overseas.

This was the first recognition of chemistry as a separate branch of the military service in any country or any war.

Later, Colonel Walker, as before stated, was transferred to the Ordnance Department, and was replaced by Lieutenant Colonel M. T. Bogert. The latter was in charge of the American branch of the Chemical Service Section at the time this section, together with all of the gas research laboratories and personnel of the Bureau of Mines, and the plant and field operations of the Ordnance and Medical Department pertaining to gas warfare, were united under Major General William Sibert, under the new title of Chemical Warfare Service.

It can not be brought out too strongly that the Chemical Service Section of the National Army was the first organized military body established for the sole purpose of relating chemistry to warfare. It took as an insignia

the old alembic of alchemy joined with the theoretical benzene ring which has so greatly accelerated the development of modern chemistry. It further adopted for its colors those of the American Chemical Society—cobalt-blue and gold.

The Chemical Service Section was of very great service, especially in systematizing the regulations of the War Department in regard to chemical personnel, and the status of chemists was ably defined through its influence, in the order of May 28, 1918. On account of its historical importance this order is quoted here.

1. Owing to the needs of the military service for a great many men trained in chemistry, it is considered most important that all enlisted men who are graduate chemists should be assigned to duty where their special knowledge and training can be fully utilized.

2. Enlisted chemists now in divisions serving in this country have been ordered transferred to the nearest depot brigade.

3. You will make careful inquiry into the number of graduate chemists now on duty in your command and report their names to this office. The report will include a statement as to their special qualifications for a particular class of chemical work, and whether they are now employed on chemical duties.

4. Enlisted graduate chemists now in depot brigades, or hereafter received by them, will be assigned to organizations or services by instructions issued from this office. The report called for in paragraph 3 herein will be submitted whenever men having qualifications for chemical duties are received by depot brigades, or replacement training camps, or by the training camps organized by the various staff corps.

5. Enlisted men who are graduate chemists will not be sent overseas, unless they are to be employed on chemical duties. Prior to the departure of their organization for overseas duties, they will be transferred to the nearest detachment or organization of their particular corps.

6. The chief of the Chemical Service Section will be charged with the duty of listing all American graduate chemists, including those in the Army and those in civil life.

7. Whenever chemists are needed by one of the bureaus or staff corps, request will be made on the chief of the Chemical Service Section for recommendations of a man having the qualifications necessary for the particular class of work for which he is desired. If men having chemical qualifications are wanted for only a short period of duty, they will be temporarily attached to the bureau or staff corps; where the duty is of a permanent nature, instructions covering their transfer will be issued. Whenever the chemists, thus attached or transferred, are no longer needed for purely chemical duties, a report will be made to the chief of the Chemical Service Section in order that they may be assigned to chemical duties at other places.

By order of the Secretary of War,

Roy A. Hill,
Adjutant General

These regulations have since been enlarged so that at present chemists may be furloughed back from the Army to colleges for instruction purposes or to industrial works for essential chemical production. Students may be continued in chemical courses to meet the future need for chemists, and any chemists in the Army may be assigned to war work wherever needed. All this has been done not for the sake of the chemists, but on account of the scarcity of trained chemists and the great need of the country for their services as chemists to help win the war. Without chemistry to-day the continuation of the war would be impossible.

A summary, necessarily brief, of the departments and bureaus utilizing chemists may be taken up in the following order:

I. Army

A. General Staff

Executive Division, Chemical Warfare Service.—This branch of the service established by General Order No. 62, already published in the chemical journals, is in command of Major General William Sibert, of the engineers. It has, according to the order above referred to, full charge of all phases of gas warfare, including research, manufacture, shell filling plants and proving grounds. It also continued the functions of the Chemical Service Section with increased authority.

All newly drafted chemists are assigned to the Chemical Warfare Service to be detailed or transferred or furloughed where needed. It is charged with the "responsibility

of providing chemists for all branches of the government and assisting in the procuring of chemists for industries essential to the success of the war and government."

It has an authorized personnel of 45,000, of which any portion may be chemists if needed. At present there are approximately 1,400 graduate chemists in the Chemical Warfare Service.

B. Ordnance Department

(*a*) *Engineering Division, Explosive Section*.—Under the direction of Colonel J. P. Harris, this division has ten commissioned and six civilian chemists. This section concerns itself with the solution of all engineering problems connected with propellants, the loading of high explosives into shells, trench warfare containers, primers, the research in high explosives, the investigation of explosives submitted for testing, efficiency of methods of manufacture and the carrying out of tests for developing substitutes.

(*b*) *Procurement Division, Raw Materials Section*.—The Chemical Branch of this division under the direction of Major W. H. Gelshenen utilizes the services of five officers whose experience has been chiefly on the commercial side of chemical industry.

(*c*) *Inspection Division, Explosive Section*.—The chemical work of this division is under the direction of Major Geo. B. Frankforter, who has a personnel of somewhat more than 1,000 chemists under his direction. Major Moses Gomberg is supervisor of special process work. The chemists are divided into three grades—"inspectors" who are responsible for all powders meeting specifications; "analytical chemists" who analyze and test all powders and report results to inspectors; "linemen" who are control chemists having charge of certain steps in the process of manufacture.

These chemists are employed throughout the United States at explosive plants, chiefly inspecting processes of manufacture and the finished product. The section maintains an officers' training school at Carney's Point for training for inspection, testing and process control of explosives. Graduates of the school are, in a few instances, commissioned; otherwise they are retained in a civilian capacity. There is a tendency to place all men in uniform as rapidly as possible. There has been such a demand for chemists that most of them have not finished the training before being given experience in the plants, so that they are obtaining their training and experience at the same time, with the expectation of returning to the school for more theoretical work before graduation.

The school at present has 150 chemists taking training with from six to ten instructors. The training consists of an extensive review of organic and inorganic chemistry, chemical engineering, including mechanics and plant operations; also a review of physics and a special study of the chemistry of explosives both in the laboratory and in the plant. The school has good laboratory facilities and a school day of ten hours. Civilians who are taken into the school are paid at the rate of $1,500 to $2,000 from the time they enter.

Recently a supervisory and control laboratory with 20 chemists has been established in Philadelphia for the purpose of making control analyses and investigating certain problems having to do with the inspection of explosives.

(*d*) *Inspection Division, Metallurgical Section*.—This division employs 79 chemists, 23 being in uniform. The work is in charge of Major A. E. White, and laboratories are maintained at 25 of the leading steel plants of the country, with the central control laboratories in the buildings of the Bureau of Mines at Pittsburgh. Also, two chemists are working in the laboratories of the Bureau of Standards for this branch of the service. With the exception of the central control laboratory and the work at standards, the work of this section consists chiefly of the analyses and control of ferrous products.

(*e*) *Production Division: (1) Explosive Section; (2) Raw Materials Section*.—This work is under the direction of Major E. Moxham, with Major C. F. Backus in charge of the Explosives Section and Major M. S. Falk in charge of the Raw Materials Section. The section numbers among its personnel 18 chem-

ists or chemical engineers engaged in executive and administrative work on the production of smokeless powder and high explosives. The section has no laboratory facilities, the work accomplished being chiefly in facilitating increased production through specializing in the various works on manufacturing problems.

The division has been concerned with the investigation of new processes for the production of raw materials, some of which have been put into operation, especially the production of toluene by the cracking of petroleum. The Raw Materials Section arranges for the production and distribution of raw materials, such as nitric acid, sulfuric acid, benzene, phenol, ammonia and sodium nitrate. Besides investigating new processes, the section studies increased production and distribution of supplies. For the main part the chemical personnel is on duty at various plants investigating production and processes.

(*f*) *Nitrate Division*.—Colonel J. W. Joyes is in charge of this Division, with Lieutenant Colonel A. H. White in charge of the Research Technical Section. The Nitrate Division was organized shortly after war began with the special duty of installing plants for the fixation of air nitrogen. It now has a personnel of 130 chemists and chemical engineers, enlisted and commissioned. It has only a few civilian chemists in its employ. It has cooperated with and received help from the laboratories of the Massachusetts Institute of Technology, the Geophysical Laboratory, the University of Michigan, the Bureau of Soils (Arlington), the Bureau of Standards and the Bureau of Mines. It has built extensive works at Sheffield, Ala. It has a small experimental plant at the Georgetown Gas Works, and another at Greene, R. I. In cooperation with the Bureau of Mines, it carried on experiments on ammonia oxidation at Syracuse, N. Y., and at Warner's, N. J. The division is one of the most important from the chemical development standpoint that has been established for war purposes. It has very large appropriations at its disposal and it has two nitrate plants in Ohio in preliminary stages of erection. It contemplates other activities in nitrogen fixation.

The Ordnance Department also runs four arsenals—Picatinny, Watertown, Frankford and Rock Island—in all of which chemists are regularly employed. The number of chemists in the arsenals has been largely increased since the war began. No figures are at the moment available.

C. Quartermaster's Corps

The chemical work of the Quartermaster's Corps involves the testing and analyses of materials, foods, leather, paper, etc., the making of specifications, and the control of materials to find if the specifications are complied with. The corps has few chemists in uniform, as the work has been done chiefly in the laboratories of the Bureau of Chemistry.

The filtration plants at the various government camps and cantonments are also under the control and direction of the Quartermaster General.

D. Surgeon General's Office

Food and Nutrition Division, Medical Department, Sanitary Corps.—This division has 91 food and biological chemists who are in uniform. In each camp there is stationed one nutrition officer who is preferably a food expert with as much physiological, biological and sanitary training as possible. His duty is to inspect all food, mess halls, refrigerators, etc., with the object of maintaing a high degree of sanitation. He has full authority to see to it that meat, for example, is destroyed if dropped upon the ground in hook worm territory; also any other food that could in any way injure the health of the men. There are three survey parties in the Sanitary Corps whose duties consist in going from camp to camp, getting information regarding garbage and collecting data on nutrition problems. This is put in the form of curves in the Washington office. The work is part of an extensive nutritional study and is expected to give important results for future use as well as for present Army needs.

Research, with reference to the physical

properties of various proteins, creatin, etc., is being carried on for the corps in the laboratory at Cambridge under Dr. Henderson. Research relative to rope disease in bread, catalytic action in relation to yeast activity, etc., is progressing, from which valuable results are already in sight. At the Harriman Research Laboratory the special problem is meat spoilage. It is hoped it will be possible to detect incipient spoilage by chemical means. At the Bureau of Chemistry, Department of Agriculture, members of the Sanitary Corps are working on garbage research and making a survey of all food furnished to the various camps. An examination is made of all garbage cans in order to determine how much of the food finds its way into the stomachs of the men. This has resulted in a great saving of food material.

At the University of Rochester investigations have been made as to the effect of temperature in desiccated vegetables, as it is thought high temperatures used in desiccation may tend to induce certain diseases, such as scurvy, pellagra, beri beri, etc. A safe temperature is being studied. Independent investigations bearing upon the work of the Sanitary Corps are being carried out in the Bureau of Chemistry.

The Sanitary Corps maintains a school for the training of nutrition officers at Fort Oglethorpe, in connection with the Medical Officers' Training School. Men sent to this school are selected from the standpoint of training and experience in food and nutrition work, together with biological training. Frequently the men are commissioned before entering the school, if they have had sufficient training, although in certain instances privates have entered the school and ben granted commissions later.

E. Aircraft Production

This Bureau now requires the services of 51 chemists in two sections. There is the Section of Chemical Research under Dr. H. D. Gibbs, who has 18 chemists (13 in uniform) engaged specifically in research problems, plant operations, study of new materials, chemical processes, methods of making new chemicals required in airplane construction, etc. Interesting studies are also being conducted on certain photographic sensitizing dyes to be used in airplane photography. This Bureau also maintains in Pittsburgh an inspection and control laboratory employing 33 chemists, 5 in uniform and 28 civilians. This laboratory has 60 technical men, of whom 30 are chemists. These chemists were afforded space in the Bureau of Standards until April 1, when they were removed to the home of the Pittsburgh Testing Laboratories, Pittsburgh, Pa. The work is in charge of Dr. H. T. Beans. The laboratory has general control of all products purchased by the Aircraft Production Board; it develops specifications for new materials and sends chemists into the plants to get the grades of materials wanted.

II. NAVY

The Navy also requires chemical aid in warfare, and at the present time has approximately 200 chemists engaged chiefly in control work and plant operation. Each of the navy yards has a control laboratory and the Ordnance Bureau has about 100 chemists, of whom approximately 20 are commissioned, 35 enlisted and 50 civilian. These are utilized in much the same capacity as in the Army Ordnance.

From the first the Navy has immediately transferred to Chemical Service the names of all chemists enlisted in the Navy, where the names and qualifications have been made known to them. While of course the total number is small, the proportionate need has apparently been greater, for there are still several hundred graduate and experienced chemists and chemical engineers, both officers and men, in the Navy, a large proportion of whom have expressed their willingness to serve as chemists if needed, but who are still in the fighting branch or whose duties have no relation to chemical service.

III. CIVILIAN BUREAUS

The Bureau of Chemistry, the Forest Products Laboratory and other bureaus of the Department of Agriculture, the chemical labora-

tories of the Bureau of Mines, Bureau of Standards, and the Treasury Department have all cooperated with their full force in any war problems presented to them. Many of these problems have originated and been carried to a successful conclusion within the bureaus themselves. The civilian personnel of the bureaus has been depleted in almost every instance by the war, but men have been assigned by the War Department to assist in war problems. For example, the Bureau of Standards at present has 70 men in uniform assigned to it from various branches of the government. These are for the main part engaged on studies of new methods of analysis, research on analysis of special materials, analysis of government supplies, and development of airplane dopes, and study of new and improved specifications on government supplies. The studies of electroplating with reference to government needs and the study of the physical characters of alloys have been taken up.

The truly extensive chemical work of the civilian bureaus and their relation to war work will be published in detail at some future time.

IV. COMMITTEE ON CHEMICALS. CHEMICAL ALLIANCE WAR INDUSTRIES BOARD

In the very early days of the war, the Committee on Chemicals, headed by Dr. Wm. H. Nichols, president of our society, and consisting of the leaders of our chemical industries, gave unstinted and invaluable service to the government in coordinating the country's chemical manufacturing resources, in increasing the output of our chemical plants, and in allocating and fixing prices to the government of the finished product.

The value of these services can not be overstated, although comparatively little has been written about them.

When the various war committees of the Council of National Defense were discontinued and their functions absorbed by the War Industries Board, the Chemical Alliance was formed to serve as a clearing house of the chemical manufacturers in their dealings with the government through the War Industries Board. It was organized primarily at the request of the Department of Commerce to assist in clearing up business questions in connection with the importation of pyrite, but later it became a regularly organized trade association, without any official government connection, to which the War Industries Board can turn for expert advice.

Some of the directors at first were original members of the Committee on Chemicals, with Dr. Nichols as president. Later Dr. Nichols retired and Mr. Horace Bowker, vice-president, was made president of the Alliance.

The War Industries Board has been active in the chemical field since its inception. It has well-organized committees to deal with chemical trade matters, especially with the allocating of material, fixing of prices, study of contracts, and a clearing of orders for both the Army and Navy.

V. NATIONAL RESEARCH COUNCIL

The National Research Council early organized a chemistry committee, of which Professor M. T. Bogert was made chairman. When later Professor Bogert was appointed lieutenant colonel in the Chemical Service Section, Dr. John Johnston was put in charge of this work for the National Research Council, and continues in that capacity.

A meeting of prominent chemists takes place in Washington in the rooms of the National Research Council twice weekly, and the conferences serve as a clearing house of research work going on in Washington and in the country. The National Research Council has from the first served as a valuable feeder and intermediary on research between the universities and the government. The council has suggested and cleared many research problems both in this country and abroad.

VI. GEOPHYSICAL LABORATORY

The Geophysical Laboratory, under the direction of Dr. Arthur L. Day, has engaged in important work since the beginning of the war. The developments which this laboratory have made in optical glass are well known and have had an important bearing on the war's progress. The laboratory has been assisting

on the nitrate investigations and other problems. The high standing of its corps of chemists is well known to all members of our society.

VII. THE WAR TRADE BOARD, SHIPPING BOARD, FOOD ADMINISTRATION, TARIFF COMMISSION

These important government departments all require chemists and utilize chemists in a consulting and directing capacity.

The War Trade Board has a member, Dr. Alonzo E. Taylor, who is assisted in passing upon chemical matters by Dr. A. S. Mitchell, Mr. B. M. Hendrix and Dr. R. P. Noble.

The chemical work of the Shipping Board has been under the direction of Dr. W. B. D. Penniman, who, while shutting off the importation of certain products, has helped produce excellent substitutes therefor.

The Food Administration has been guided in chemical matters chiefly by Dr. Alonzo E. Taylor and Mr. Charles W. Merrill.

The chemical work of the Tariff Commission is under the direction of Dr. Grinnell Jones, who this morning gives you a full description of the information being gathered by the Tariff Commission on chemical matters to guide it in its recommendations to Congress, both during and after the war.

Many departments of the government have been in constant communication with our allies on research and industrial chemical matters. Chemical liaison officers have been sent from the Army and Navy and some of the civilian bureaus to keep in touch with foreign development and practise, and their services have been invaluable. In this connection it should be particularly pointed out that not all of the development of chemistry in this country is our own accomplishment, for we have obtained information of the highest importance through the efforts of these liaison officers. On the other hand, chemical information of the highest importance has been sent from America to Europe.

War, the destroyer, has been on the other hand the incentive to marvelous chemical development with a speed of accomplishment incomprehensible in normal times. Discoveries made in the search for instruments of destruction are already in use for the development of chemical industry. Many others, unpublished as yet, and to remain unpublished until the war is over, will prove of the utmost benefit to mankind. The same agencies that add to the horror of war to-day, the same reactions which are used in the development of explosives and poisonous gases, on the one hand, and in counteracting their effect, on the other, will find immediate and useful application in the years to come.

The war has been prolonged by chemistry. The German chemist apparently working for years with war in view has supplied the German armies with the means for their ruthless warfare, but the chemists of America and our Allies have met them fully in chemical development, and when the chemical story of the war is written where all can read, it will be the verdict of history that the chemists of America were not found wanting.

The chemical program of the United States Army and Navy has been at all times ahead of our trained man power and the mechanical devices necessary to apply what the chemists of America have produced.

CHARLES L. PARSONS,
Chairman of the Committee on War Service for Chemists

SCIENTIFIC EVENTS

THE CAWTHRON INSTITUTE OF SCIENTIFIC RESEARCH

WE learn from the *New Zealand Journal of Science and Technology* that at a meeting of the Cawthron trustees held on May 30, 1918, the appointment of the advisory board was confirmed for six years from the date of their appointment on September 25, 1916. The advisory board consists of Sir James G. Wilson (chairman), Professor W. B. Benham, Dr. L. Cockayne, Professor T. H. Easterfield, Dr. P. Marshall and Professor R. P. Worley.

The advisory board, in conjunction with the chairman of the trustees, is to make inquiries in regard to the appointment of a director, such director to be a chemist with biological

leanings, and to be a man of fair business ability.

It was resolved that the Cawthron trustees approach the government with a view to the appointment of two scientific investigators to operate in the Nelson District with a view to finding out the causes and cures of certain blights; and that the trustees are willing to place at the disposal of the government the sum of £1,000 per annum for a period of two years on condition that any results obtained be the joint property of the government and the Cawthron Institute.

The regulations for the Cawthron Minor Scholarship are now published, and copies may be obtained from Messrs. W. Rout and Sons (Limited), Nelson. Candidates must be British subjects, and the scholar must matriculate at a university college and study for the B.Sc. degree, and sign a declaration that he will, after graduation, accept (if offered) a Cawthron Scholarship of £150 per annum, and pursue his studies for not less than two years at the Cawthron Institute. The Minor Scholarship is of the value of £80 per annum, plus the fees for attendance at university classes up to the amount of £25 per annum. The tenure of the scholarship is for three years. Preference in the selection of a scholar shall be given (*ceteris paribus*) to candidates from Nelson and Marlborough. The scholarship will be awarded on the science papers of the University Scholarship Entrance Examination in not less than two nor more than three of the following subjects: Mathematics, physics, chemistry and botany. The marks obtained, together with a criticism of the work of the first three candidates in each subject, are to be forwarded to the advisory board, which shall then recommend that candidate for election who appears to give the greatest promise of being useful to the institute.

The second annual Cawthron lecture was delivered in the School of Mines, by Professor W. B. Benham, M.A., D.Sc., F.R.S., on May 30. The subject chosen was "Biology in relation to agriculture," and the lecturer devoted particular attention to the problems of fruit-growing and the kinds of research the institute should attempt. These include inquiries into the efficiency of different kinds of sprays on different kinds of trees, the most productive method of pruning, and the most suitable and economic methods of manuring. Other matters that ought to receive attention are: (1) A thorough-going soil survey—the investigation of the chemistry, physics and biology of the soil, and especially of the humus and its effect on plant-growth, of which little is as yet known; (2) an extended program of investigation of the diseases that attack our plants, and especially those that are injurious to the fruit-tree.

The lecture, together with the first annual lecture by Professor T. H. Easterfield, is to be published by the institute.

THE INTERNATIONAL INSTITUTE OF AGRICULTURE AT ROME[1]

THE operations of the institute have been, of course, profoundly affected by the war. At the beginning of hostilities its very existence seemed dubious. As its vice-president, M. Louis-Dop, has pointed out in a recent report reviewing its history and progress, the question was immediately raised as to the possibility of maintaining, in a conflict which has transformed the political and economic conditions of every continent, an organization based upon the collaboration of nations, the working together of a committee representing all the powers, belligerent or neutral, and the efforts of a personnel of international composition. Notwithstanding these obstacles, the continuation of the enterprise was decided upon. Apparently it was felt that the institute had been established as a permanent institution and the suspension of its operations should be avoided if possible. More than this, it was expected that the usefulness of the institute to the world would be in many ways intensified by the war conditions.

The work of the institute has, therefore, been carried on so far as possible. No nation has abrogated the treaty, so that all are full members as before. Meetings of the permanent committees have been held regularly, and each of the bureaus has been performing its func-

[1] From the *Experiment Station Record.*

tions much as in 1914, although crop reports and similar data have been withheld by the Central Powers.

The immediate result of the war upon the institute has been on the whole to increase and stimulate its activities. The need for accurate statistical data regarding the world's food supply has never been so urgent. Information as to improved farm methods and economic measures has been eagerly sought for and with more prospect than ever before of its practical utilization. As regards technical material, particular efforts have been made to render available data as to means of diminishing the impoverishment of the soil, overcoming the shortage of fertilizers and labor, and increasing the use of farm machinery. A special function has been the answering of inquiries regarding agriculture in countries whose own agricultural and statistical departments have been disorganized by the war. It is announced that these various efforts of the institute have met with unusual appreciation from the governing authorities of many nations.

The officers of the institute are also looking forward quite optimistically to the future of the institution after the war. They believe that the return of peace will bring with it vast agricultural problems of international significance, and that during the reconstruction period the institute will have a specially important function to perform. There will be a great demand for accurate information along statistical, economic and technical lines, much of it international in its scope, and for the collection and dissemination of which a central clearing-house, such as this, will have unique possibilities. The institute is already making plans for service in these directions, and more specifically in such projects as the control of locusts, the improvement of the economic status of the farmer, the establishment and development of small holdings, maritime transportation of farm products, the unification of methods for agricultural statistics, farm accounting, control of seed adulteration and concentrated feeding stuffs, and the development of rural sociology.

Despite the unexpectedly difficult problems it has encountered, the institute thus enters upon the second decade of its operations with its organization virtually intact, its publications and other lines of work going on with little interruption, and an ambitious program being formulated for the future.

THE MUSEUM OF THE UNIVERSITY OF PENNSYLVANIA

The University Museum has entered upon an extension of its educational features by the addition of four women to its staff for the purpose of assisting visitors. There will also be an information desk near the entrance door for the accommodation of all comers. Every day, including Sunday, there will be present a professional artist to assist students, professional or designers, who may come to the museum to seek inspiration from its many art and ethnological treasures. A new curator has been employed to assist visitors in examining the collections from Mesopotamia, Greece, Italy and Egypt. The curator of the Oriental Section and the curator of the American Section will be present at all times to assist those who desire to study these exhibits. While the University Museum has always laid stress on its educational features and it has been visited by artists and designers as well as by scholars and the public generally, the management believes the time has arrived when very special efforts should be put forth to make the museum a more integral factor in the commercial as well as the artistic and cultural life of the community. Its new assistants will devote themselves especially to this feature in the particular desire to aid those who are seeking new artistic designs. In explanation of its new work the University Museum makes the following statement:

> It is realized everywhere that this war is to have a profound effect upon the artistic and cultural world. Not only has much of the accumulated artistic beauty of the world been destroyed, but many of the creators of art have lost their lives in the struggle. Reconstruction is not likely to be along the same lines as formerly, for it is certain that there will be new ideals and new inspiration growing out of this war in all countries.

Hitherto the United States has either imported artists or art, or else its people have followed rather slavishly the ideals of Europe. This is especially true in the matter of design as affecting fabrics, textiles, wallpapers, furniture and decoration generally. The University Museum believes that this no longer will be the case. Even the old world nations will branch out on new lines. It would seem as if the greatest nation on earth, that which is raising the greatest army and commercial navy in the world, that which is destined to give the deathblow to the nation which is the foe of all art, the nation which has exceeded all others in invention for the material comforts of mankind, assuredly it seems that such a nation has within itself the power of creative imagination to establish its own school of independent art.

All art harks back more or less to former achievements, but the genius of a nation as of an individual is shown by the original use made of such available material. The University Museum has within its walls collections which have cost millions of dollars and which are valuable for more than their mere objective beauty or cultural qualities. They cover the whole field of civilization from the earliest dawn to the present, and practically every tribe and nation as well as every field of artistic achievement.

It is the belief of the managers of the University Museum that in its rich and rare collections of the art of the past as well as of the primitive races still existing there will be found inspiration and stimulus to aid in developing a truly American art.

Without going into the larger aspects of the situation it can be said that this city which owes so much of its prosperity to manufacture of textiles, furniture, wall-papers and other decorative objects will have a wide field of opportunity before it when the war ends. The nation is building the greatest commercial fleet in the world which it announces is to be used for trade as soon as peace comes. To secure trade this nation and this city must provide the best and most beautiful of commodities or give way to other nations who will supply the demand.

There are thousands of objects in the University Museum ranging from the treasures of ancient Egypt, Crete, Persia, Greece, Italy and South America and the primitives of Oceanica from which inspiration can be drawn with excellent results. It is not presumed that there will be any lavish copying but in this wide range of objects there will be found designs or color schemes which will afford scope to the creative imagination of artists and designers.

WESTERN RESERVE UNIVERSITY MEDICAL GROUP

Two years ago a plot of land which approximated fifteen acres in extent, known as the Ford Estate, was purchased as a site for the new buildings of the Medical Department of Western Reserve University and for a new Lakeside Hospital, for a babies' and for a maternity hospital. It was the plan to create a group of hospital buildings combined with the medical school to make an ideal teaching plant for the teaching of medicine. This tract is situated next to the literary departments of Western Reserve University and the Case School of Applied Science. Although the war has postponed the erection of any of these buildings, Lakeside Hospital lately received some noteworthy contributions and bequests which will materially hasten the building.

By the will of the late Colonel Oliver Payne, a large and generous gift of one million dollars come to Lakeside to be used at the discretion of the trustees. By the will of the late Mr. W. S. Tyler, Cleveland, a trustee of Lakeside, a bequest of two hundred thousand dollars came to Lakeside to be used at the diserection and endowment of a maternity ward on the new site. Mr. Samuel Mather, president of Lakeside, opened the new building fund of the hospital by a gift of three hundred and fifty thousand dollars. There is also a fund held by the trustees of Lakeside for the benefit of the children's and maternity wards amounting to something over one hundred and fifty thousand dollars.

By these gifts the realization of the plans for an ideal teaching group are brought nearer.

THE NEW YORK POST-GRADUATE MEDICAL SCHOOL

Seven members of the laboratory staff of the New York Post-graduate Medical School and Hospital are in government service. Ward J. MacNeal, M.D., Ph.D., professor of bacteriology and director of laboratories, is now a major in the Medical Corps and in charge of the Central Laboratory of the Medical Department, France. Richard M. Taylor, M.D., professor of pathology, now a captain in the Medical Corps, is likewise doing laboratory

work in France. Arthur N. Tasker, M.D., lecturer in tropical medicine, a lieutenant colonel in the Medical Corps, is Sanitary Inspector of the Intermediate Section, France. J. Wheeler Smith, M.D., associate in bacteriology, now a lieutenant in the Medical Corps, is doing research work with Colonel Whitmore at the Army Medical School. Anton R. Rose, Ph.D., associate in pathological chemistry, is a captain in the Food Division of the Sanitary Corps. W. L. Aycock, M.D., instructor in bacteriology, a lieutenant in the Medical Corps, is in charge of the laboratory of the U. S. Army Hospital, No. 8 (Post-graduate), France. Arley Munson, M.D., who was appointed instructor in bacteriology in Dr. Smith's place, is now with the Red Cross and bacteriologist to the Blake Hospital, Paris. Colonel J. F. Siler, a member of the Robert M. Thompson Pellagra Commission of the Laboratory of Tropical Medicine, is in charge of the Laboratory Department of the Medical Corps, American Expeditionary Forces. The laboratories of the school are now under the charge of Victor C. Myers, Ph.D., professor of pathological chemistry. During the absence of members of the regular staff, Louise H. Meeker, M.D., is instructor in pathology, Adele E. Sheplar, M.D., instructor in bacteriology, and Anne G. Dellenbaugh, B.A., instructor in bacteriology.

Emma L. Wardell, M.S., has recently resigned as assistant in pathological chemistry to become assistant professor of household economics at the University of Illinois. John A. Killian, Ph.D., has been promoted to be associate in pathological chemistry. Owing to the emergencies of the war the board of directors is admitting women, who are graduates of recognized colleges, though not graduates in medicine, to courses in the laboratories. A number of such women have already been appointed to positions in the cantonment hospital laboratories. A new course in bacteriology begins on November 1.

SCIENTIFIC NOTES AND NEWS

Colonels James D. Glenman, William S. Thayer and John M. T. Finney have been promoted to be brigadier-generals in the Medical Corps.

To secure closer cooperation between American and British educational institutions, a mission headed by Dr. Arthur Everett Shipley, vice-chancellor of the University of Cambridge, has arrived in this country. In addition to Dr. Shipley, the zoologist, the mission includes two other men of science, Sir Henry Alexander Miers, formerly professor of mineralogy at Oxford, and Dr. John Joly, professor of geology and mineralogy in the University of Dublin.

Colonel Champe C. McCulloch, Jr., M.C., U. S. A., executive officer of the Board for Collecting and Preparing Material for a Medical and Surgical History of American Participation in the European War, has arrived in France, to establish his administration for this purpose. During his absence Lieutenant Colonel Casey A. Wood, M.C., U. S. A., will be in charge of this work in the Surgeon-General's Office.

Professor Frederic S. Lee, of Columbia University, has been sent to England and France on a special mission by the United States Public Health Service.

J. S. Jones has resigned as director and chemist of the Idaho station and professor of agricultural chemistry in the University of Idaho, and has assumed charge of the operating laboratory of one of the government nitrate plants under the Ordnance Division of the War Department.

Dr. Lorande L. Woodruff, professor of biology in Yale University, is serving as consulting physiologist in the Chemical Warfare Service, N. A.

William S. Bacon has been promoted to be a major in the Chemical Warfare Service and is now in command of the Lakehurst Proving Ground, Lakehurst, N. J.

Frank A. Waugh, head of the division of horticulture and professor of landscape gardening at the Massachusetts Agricultural College, is on leave of absence to fulfil his appointment to a captaincy in the Army Sanitary Corps.

Dr. H. K. Benson, director of the Bureau of Industrial Research, University of Washing-

ton, has been commissioned captain in the nitrate division of the Army Ordnance Department.

Dr. J. M. Lewis, associate professor of botany at the University of Texas, has been commissioned a captain in the Sanitary Corps and has reported at New Haven, Conn.

H. C. Young, of the botanical department, Michigan Agricultural College, has been given indefinite leave of absence, having been appointed second lieutenant in the Sanitary Corps with headquarters for the present at the Yale Army Medical School.

E. R. King, assistant professor of entomology at Cornell University, has been commissioned a second lieutenant in the Aviation Corps.

Ross A. Baker, chief gas officer, Camp Pike, Ark., has been made officer in charge of gas training for Chief Gas Officers, Army Gas School, Humphreys, Va. Mr. Baker was formerly assistant professor in chemistry at the University of Minnesota.

Olaf P. Jenkins, assistant professor of economic geology of the State College of Washington, has been appointed geologist to the Arizona State Bureau of Mines, Tucson, Ariz. The first geological work to be done will be the preparation of a general geologic map of the entire state.

G. D. Cain, chief chemist of the fertilizer control laboratory at the Louisiana Agricultural Station, has been appointed assistant director of the North Louisiana Station at Calhoun.

Mr. Arthur Lowenstein, for many years a fellow of the American Association for the Advancement of Science, formerly technical director of Morris and Co., and lately a consulting chemical engineer of Chicago, has recently been elected vice-president of Wilson and Co.

Professor John Weinzirl has returned to the University of Washington at Seattle, after spending a year's leave of absence in study at the Harvard Medical School, where he received the Dr.P.H. degree. He was also engaged in the food poisoning investigation directed by Dr. M. J. Rosenau, taking up the special problem of the microorganisms found in canned foods.

Professor H. C. H. Carpenter, the president of the Institute of Metals, London, has been nominated to fill the office for a further year.

Dr. H. S. Hele-Shaw and Signor Marconi have been elected honorary fellows of the Society of Engineers, London.

We learn from *Nature* that Sir John Marshall, director-general of archeology in India, has, in consequence of illness, been granted leave of absence, during which his deputy will be Dr. Spooner, superintendent of archeology, Eastern Circle.

At the request of the rector of the National University of Mexico, Dr. N. Leon, professor of anthropology, has been appointed the representative of Mexico in the Congress de Americanistas. which is to convene at Rio de Janeiro in June, 1919.

Nature states that the council of the South African Association for the Advancement of Science has resolved to institute a Sir David Gill memorial fund, to accumulate for a number of years until an amount has been raised adequate for some purpose to be decided upon. Mr. R. T. A. Innes, Union Observatory, Johannesburg, is the secretary and treasurer of the fund.

The Training Camp for the Chemical Warfare Service, now under construction at Lakehurst, N. J., has been designated "Camp Kendrick," in honor of the late Colonel Henry L. Kendrick, who, after service as a commissioned officer, served as professor of chemistry, mineralogy and geology at the U. S. Military Academy from 1857 until his retirement from active service in 1880.

Professor David Ernest Lantz, assistant biologist in the Biological Survey, United States Department of Agriculture, died of pneumonia on October 7, at his home in Washington, D. C. He was engaged chiefly in investigations of the economic relations of mammals and was the author of many reports and special papers on this subject.

Lieutenant Herbert Douglas Taylor, for three years an associate of the scientific staff of the Rockefeller Institute for Medical Research died on October 5, of pneumonia in his thirtieth year. Since America entered the war Lieutenant Taylor had devoted his time to the instruction of the United States Army surgeons for overseas service.

Walter W. Marshall, formerly instructor in zoology in the University of Minnesota, died at Camp Sherman, Ohio, on October 4, while attached to the Base Hospital.

Hamden Hill, research chemist of the Texas Oil Co., Bayonne, N. J., plant, died at St. Luke's hospital, New York City, on September 23, 1918, as the result of burns due to an explosion of gasoline vapors in the laboratory.

The death is announced of Dr. A. Mendoza, the pioneer of microphotography in Spain, chief of the laboratory of the Beneficencia provincial and of the scientific institute in charge of Professor Cajal.

Henry Suter, author of "A Manual of the New Zealand Mollusca," died in Christchurch, New Zealand, on August 1. A correspondent in New Zealand writes that he was born in Zurich Switzerland, in 1841, and went to New Zealand in 1886 to engage in farming, but soon relinquished the idea and devoted most of his time to studying the indigenous mollusca of the antipodean country. He contributed papers to the *Transactions of the New Zealand Institute*, the *Journal of the Malacological Society*, London, and other periodical publications. In 1913 he produced his "Manual," which was published for him by the New Zealand government. It contains the diagnoses of 1,079 species, 108 subspecies and 100 varieties of New Zealand molluscs. Two years later, the government published his atlas to the "Manual." This has 72 plates, containing many figures of molluscs from Mr. Suter's own drawings. In later years he gave special attention to Tertiary molluscs of New Zealand, and in 1916 the Geological Survey Department published as a bulletin a work by him on "The Tertiary Mollusca of New Zealand." His death leaves New Zealand without a recognized conchologist.

The first regular meeting of the New York Section of the American Chemical Society was held on October 11. Previous to the regular meeting a portrait of the late Charles M. Hall, presented to the Chemists' Club, was unveiled, and Mr. Arthur V. Davis, president of the Aluminum Company of America delivered an address. The regular meeting was devoted to the subject of the Bureau of Foreign and Domestic Commerce, Washington, D. C., and its relations to the business side of the American chemical industry, particularly to help us in gaining complete national chemical independence. C. D. Snow, assistant chief, Bureau of Foreign and Domestic Commerce; subject: "The ways in which the bureau aids American chemical business," with special consideration to German chemical business methods. C. P. Hopkins, editorial department, Bureau of Foreign and Domestic Commerce, subject: "Our publications and how they help chemical business," special consideration to foreign business. Dr. E. R. Pickrell, special agent, Bureau of Foreign and Domestic Commerce, subject: "How statistical information is obtained from import invoices." Special consideration to the forthcoming chemicals census.

Women chemists are needed by the government and also to stabilize the industries by replacing men chemists who have been called into service, according to Major F. E. Breithut, of the Chemical Warfare Service, U. S. A. This call is so urgent that he has asked the Women's Committee of the Council of National Defense to cooperate with the Army Medical Department in making a census of all the available women chemists in the country.

We learn from the *Experiment Station Record* that in connection with Idaho University a substation for the study of problems incident to high altitudes was authorized at the last session of the legislature. Action has been taken by the board of regents looking toward its establishment on state land at Felt, in Teton County, at an elevation of approximately 6,300 feet.

UNIVERSITY AND EDUCATIONAL NEWS

Firms in Manchester have offered to the College of Technology, Manchester, the sum of £3,000, spread over a period of five years, towards the cost of establishing a new department of industrial management.

According to the *Journal of the American Medical Association* the conflict that has been going on in the University of Cordoba has grown more acute. The rector and several of the members of the faculties have presented their resignations. The head of the national government has appointed the minister of public instruction to take charge of the matter personally, and reorganize the staff of the university. At the request of the minister of public instruction, the medical faculty of the university of Buenos Aires did not appoint a new dean at the close of the term of office of Dr. Bazterrica, and this post is filled provisionally by the member of the university council who has been longest in office, Dr. E. Canton, until the reorganization of the university statutes has been sanctioned.

Dr. Withrow Morse has been appointed professor of physiological chemistry in the medical school of the University of West Virginia, Morgantown.

Dr. Eugene L. Porter, instructor in physiology at the Medical School of the University of Pennsylvania, has accepted the position of assistant professor of physiology at the Western Reserve University Medical school.

Owing to the death of Professor R. E. Sheldon and the resignation of several members of the staff, the department of anatomy, University of Pittsburgh has been reorganized. The present members of the instructing staff are Professor Robert Retzer, associate professor C. C. Macklin and Assistant Professor Harley N. Gould.

DISCUSSION AND CORRESPONDENCE

CORRELATION OF THE HYDROGEN-ION EXPONENT AND OCCURRENCE OF BACTERIA IN SOIL

In an interesting note in Science (Vol. 48, pp. 139–140), followed by a fuller account in the *Journal of Agricultural Research* (Vol. 14, No. 7, pp. 265–271, 1918), Mr. P. L. Gainey has recently described experiments showing that the occurrence of *Azotobacter* in soils is controlled, apparently to a major extent, by the hydrogen-ion concentration, the limiting hydrogen-ion exponent being about 6.0. Previously to this, Christensen in Denmark had described some experiments on this general subject,[1] besides those reviewed by Gainey.

Christensen mentions having applied the *Azotobacter* test and the litmus paper test together to about 40,000 soil specimens. He found a general correlation between acidity to litmus and absence of *Azotobacter*. He also found a close correlation between the *Azotobacter* test and a para-nitrophenol test: "In the case of soils showing a neutral reaction for litmus, there is a distinct difference between the two groups,—with and without *Azotobacter* vegetation,—for the former colors the liquid (para-nitrophenol) somewhat more yellow than the latter." In applying para-nitrophenol, a solution of it was mixed with the soil, and the soil particles allowed to settle out over night.

There is considerable objection against mixing the indicator with the soil mass, and especially in the case of a one-colored indicator like para-nitrophenol, for any loss of indicator due to absorption by the soil mass would not be distinguishable from an actual color discharge due to acidity. The procedure of Christensen has been checked only by means of the litmus paper and the *Azotobacter* test itself. If the absorption of indicator is not serious, the results of Christensen can be interpreted in terms of hydrogen-ion exponent and are then in accord with the results of Gainey, for the turning point of para-nitrophenol is about 6.

The procedure used by Gainey, on the other hand, is the one used by the writer in 1916, tested by means of electrometric measurements of the soil suspension, and found to give at least approximately correct results.[2]

[1] *Soil Science*, Vol. 4, pp. 115–178, 1917.

[2] *Jour. Wash. Acad. Sci.*, Vol. 6, pp. 7–16, 1916.

The procedure involves the use of brilliant two-colored indicators, such as those recommended by Clark and Lubs, applied to soil extracts obtained without filtration by the use of a centrifuge.

In work being published elsewhere, L. A. Hurst and the writer have compared the electrometric method with the improved colorimetric method as described by Clark and Lubs[3] and have found a very close agreement in the results of the two methods applied to soils. We have found it advisable for soil work to use the phenol-sulfon-phthalein indicators in water solution as the monosodium salts, and to use (pure) methyl red, without neutralization, in alcoholic solution.

In previous papers from this laboratory the suggestion has been made that the occurrence of the common potato scab may be limited by the hydrogen-ion concentration of the soil.[4] In the work mentioned above this seems to have been demonstrated.

There have been located now two points of interest on the scale of hydrogen-ion exponents for soils: (about) 6.0, the acid limit for *Azotobacter,* and (about) 5.2, the acid limit for the potato-scab organism. In addition to these organisms, other important soil organisms have been studied in their relation to hydrogen-ion exponent in culture media.[5] In general, such pure culture studies should be supplemented with soil studies, for a number of reasons, one of which is that strains of unusual resistance to acidity might be missed in the study of a limited number of strains in pure culture.

From the considerable quantity of work done some years ago in culture media, it was to be expected that limits of hydrogen-ion concentration should be discoverable for the growth and survival of microorganisms in soil, providing only that the soil has a definite and significant hydrogen-ion concentration. That the soil has definite and biologically significant hydrogen-ion concentration has been demonstrated by the work of this laboratory. The expectation may be different with regard to the growth of crops, since (1) very little work involving real control of hydrogen-ion concentration has been done on this subject,[6] and (2) the welfare of crops may depend in some cases on the success of *Azotobacter,* of legume bacteria, or of other microorganisms less resistant to acidity than the plant itself. We do not yet know whether, for instance, a point can be located, in acid soils not altogether infertile, beyond which acidity the growth of red clover is always more or less unsatisfactory; we have seen, however, some indications that such a point may exist at about the exponent 5.

L. J. Gillespie
Bureau of Plant Industry,
Washington, D. C.

[3] *Jour. Bact.*, Vol. 2, Nos. 1, 2, 3, 1917.

[4] Gillespie and Hurst, *Soil Science*, Vol. 4, pp. 313–319, 1917, and Gillespie, *Phytopathology*, Vol. 8, pp. 257–269, 1918.

[5] *E. g.*, E. B. Fred, *Abstracts of Bacteriology*, Vol. 2, pp. 10–11, 1918.

[6] See Hoagland, *Soil Science*, Vol. 3, pp. 547–560, 1917, who studied the barley plant.

THE NEED OF ANOTHER PHILANTHROPIST BY ORGANIC CHEMISTS

Wanted, available sets of the greatest of all reference books in organic chemistry, Beilstein's "Handbuch der Organischen Chemie," for the immediate use of organic chemists in the numerous governmental and industrial laboratories. Why? Because these chemists have been laboring under a serious handicap for the past four years, especially in the preparation of war chemicals and explosives, medicinals, and dyestuffs. How can this pressing need be met? In a timely editorial in the September number of *The Journal of Industrial and Engineering Chemistry* Dr. Charles H. Herty has shown that photographic methods are available for the reproduction of this valuable work at a comparatively low cost. Who is to finance the preparation of the zinc etchings? There is probably some man of wealth who can appreciate the present need of the organic chemist and come to the rescue. The need is urgent. It should be met and met immediately.

The first appeal[1] for financial assistance in

[1] Science, N. S., Vol. XLVII., pp. 225–228 and pp. 590–591.

the preparation of rare and difficult organic chemicals has brought about the establishment of a source of supply of organic reagents for research in colleges and universities and for industrial purposes. This was met by an industrial establishment[2] which set apart a separate section of its laboratory for this purpose.

It seems to me that the present emergency is still more urgent. A tremendous amount of time is lost by the chemist in looking through the literature in the libraries for the details of preparation and properties of known organic compounds. Beilstein's "Handbuch" is a compilation of all the organic chemicals existing at the time of its publication. The need of available sets of this standard work of reference is self evident.

To quote the editorial in part:

> We would suggest and urge a reprinting of Beilstein under conditions which would make it available quickly to all organic chemists. To do this through the ordinary process of linotyping and proof-reading would be impracticable because of the present shortage of labor and the lack of knowledge of German on the part of linotypists and proof-readers accustomed to chemical literature. Fortunately, photographic methods are available, requiring a minimum of labor and insuring speed and absolute accuracy of reproduction.
>
> To make the proposition definite we have obtained prices for zinc etchings from one of the largest engraving houses of New York City. For the 11,126 pages of Beilstein the cost of zinc etchings at standard prices would be $30,040.20. For paper and press work (calculating on the quality of paper and charges for press work in publishing this journal), $6,119.30 would be required for one thousand sets, making a total of $36,159.50. Allowing for constantly advancing prices, and for royalty charges, $40,000 should safely cover the entire costs, not including binding, of course.
>
> Do we feel any qualms of patriotic conscience about such a reproduction? Well, we should worry! Germans are daily profiting in the conduct of the war through the utilization of American inventions, the submarine, the telegraph, the telephone, the machine gun and what not. Let some one donate $30,000 and let the sets be sold at $10 each (the ordinary cost is $100) so that every organic chemist could have one right at his hand, then—let the Germans worry.

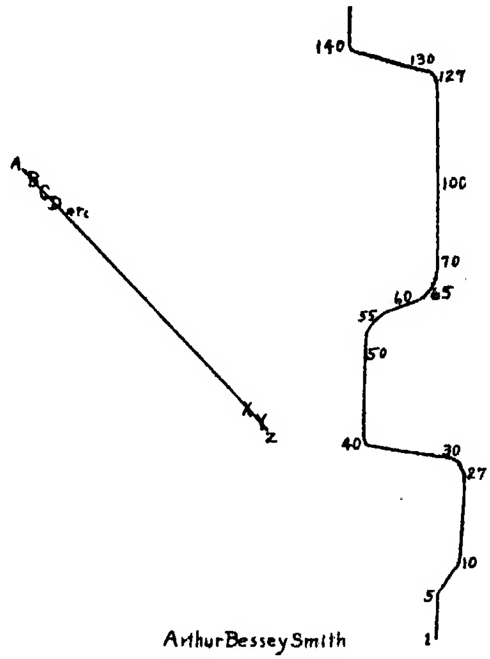
A donation for this worthy cause would be a lasting memorial to any man, and would place him among the great benefactors to the science of chemistry. Who is the philanthropist that will *immediately* set the zinc to etching?

CLARENCE AUSTIN MORROW
DIVISION OF AGRICULTURAL BIOCHEMISTRY,
UNIVERSITY OF MINNESOTA

[2] SCIENCE, N. S., Vol. XLVII., pp. 91–92.

COLOR ASSOCIATION

TO THE EDITOR OF SCIENCE: The letter from David Starr Jordan[1] called to my attention a fact which I did not know before. On mentioning it to my laboratory assistant, Mr. Herbert Edward Clapham, he said that he, too,



associated colors with the letters of the alphabet, but not with all, and that figures were also associated with colors. At my request he wrote out the following list.

A gray	O black	1 white
B light red	P brown	2 red
C black	Q — — —	3 light red
D pink	R — — —	4 gray

[1] SCIENCE, September 28, 1917, pp. 311–312.

E scarlet	S white	5 white
F pink	T red	6 white
G — — —	U golden brown	7 golden
H yellow	V gray	8 brown
I white	W — — —	9 red
J white	X — — —	0 black
K — — —	Y white	
L — — —	Z red	
M olive green		
N olive green		

Although I have never associated colors with letters or figures, from my earliest recollection I have always thought of letters and of figures arranged in the relative positions shown on page 395. The origin of this I do not know. It might have been something in the presentation of these things by my first teacher, or the manner in which little wooden sticks were laid out on my desk in the first number work. These little sticks, each about 3 mm. in diameter and 20 mm. long, had been split out of pine for me by my father. Occasionally I used to chew up one of them, because it tasted sweet.

Arthur B. Smith

Evanston, Ill.

QUOTATIONS

WAR AND ENGINEERING EDUCATION

Last week some 500 colleges opened their doors to receive some 150,000 students. These young men were inducted into the Students' Army Training Corps and have thus become candidates for commissions in the army. The part of the engineering colleges will be to train men especially for the Engineer Corps, the Signal Corps and the Chemical Warfare Service, and it may be noted with pardonable pride that the training previously given in engineering is considered the best preparation for these branches of the service. Under the new regime, however, the maximum time allowed for the full engineering course is two years, including work in the summer quarters, and the further training of men with advanced standing will be curtailed accordingly. Each college will be expected to outline its courses much on its own initiative, especially for men who have already spent a year or more in that institution.

At this stage of the development of engineering education for war we are reminded of the work done by teachers in the engineering colleges beginning a year ago last May, when they were asked on about two weeks' notice to prepare to receive men for training in military aeronautics. While the lecture material and laboratory apparatus were collected and arranged under difficult circumstances, the officers in responsible charge in Washington were enabled to choose the best methods developed in the six different schools and thus quickly arrange a satisfactory training course. It is to be hoped, however, that the engineering colleges will not follow in the footsteps of the aviation schools in at least two respects. It seems undesirable to put civilian instructors in uniform and certainly a mistake to have them decorated with brevet officers' bars. An instructor with any character should have no trouble in gaining the respect of his classes in this serious undertaking. Again, in the matter of standardization we trust the engineering colleges will not make animated phonographs of their teachers.

It is quite evident that the War Department has outlined an excellent device for producing a high grade of men to lead the army. Those who are left behind in their college work are transferred to army cantonments, while those who complete their college courses with credit are sent to officers' training camps and there must prove their ability to handle men before they receive commissions. Only the most capable men will survive such tests.

While we are thus assured that the primary purpose of developing a high class of officers will be attained, it is interesting to speculate upon the effect of this intensive training on engineering education. Much of the preliminary work in mathematics, languages and science will be eliminated or curtailed, and we shall have an opportunity to view the results of this system of education, provided that the war lasts several years. On the one hand, it is doubtful if these men will have the training which will probably be required for meeting the tremendous problems of reconstruction. It would seem desirable, therefore, to encourage them to complete their engineering prepara-

tion after the war, and the plan of giving credit for the intensive war courses toward a degree in engineering should be adopted. On the other hand, it is reasonably certain that the character of the men who complete the new engineering courses will be excellent, and the colleges should insist upon this high standard of scholarship and character after the war.—*The Electrical World.*

SCIENTIFIC BOOKS

Annals of the Astronomical Observatory of Harvard College. Vol. 79, Part 1. 4°, pp. 86; Vol. 83, Part 2, 4°, pp. 28; Vol. 91, 4°, pp. 290. Edward C. Pickering, Director. Cambridge, Mass. 1918.

The *Annals of the Harvard College Observatory* occupy a unique position in the literature of astronomy by reason of their great extent and the wide range of subject matter included in them. Collectively they form an impressive memorial to the indefatigable director who has inspired the production and publication of more than three fourths of the four score volumes composing the series. In diversity of subject matter, in successful coordination of effort and in condensed presentation of material the three volumes briefly cited above are typical of the institution from which they come.

The first of the three, prepared by Leon Campbell, contains observations of three hundred and twenty-three variable stars made during the years 1911-16, in continuation of a program commenced twenty-two years earlier. In accordance with the general policy of the observatory its purpose is the accumulation and preservation of reliable data for future study of the changes in the amount of light received from stars of the class designated variables of long period. These changes of brilliancy are notoriously irregular in character and our knowledge of the causes upon which they depend is only fragmentary. The relation between these causes and the data furnished by the present volume is committed to the future investigator.

The second volume cited, prepared under the direction of Alexander McAdie, lies in the very different field of meteorology and contains observations made at Blue Hill Observatory (Mass.) in the year 1917. Apart from a brief preface the work is wholly tabular in character and contains both in detail and in summarized form the customary meteorological data.

The last of the volumes named above, prepared jointly by Annie J. Cannon and Edward C. Pickering is an initial installment of the Henry Draper Catalogue of Stellar Spectra, to be completed in seven more similar volumes. For the most part its pages are tabular in character and are intended to place at the disposal of the theorist, data as accurate and as extensive as can be derived from the great store of Harvard photographs of stellar spectra, relative to the spectrum and magnitude of a great number of stars, so chosen as to be typical of every part of the sky. These photographs, taken partly at Harvard and partly in Peru, have been laboriously examined and classified by Miss Cannon and others and the result of four years of such labor is a catalogue showing as its chief data the magnitude and the spectral type for more than 200,000 stars. The classification is naturally upon the system originated at Harvard and now in general use, in which for the most part, stellar spectra constitute a continuous sequence whose chief divisions are represented serially by the letters B, A, F, G, K, M, with subdivisions of these classes upon a decimal system. The physical significance of this series is recognized to be of fundamental importance in every investigation of the larger problems of stellar astronomy. In accordance with its distinctly enunciated plan that we have noted above, the present volume is devoted to the preparation of material out of which the implications of this series may be worked more perfectly than has yet been done. As a contribution to that end the introduction to the volume contains explicit definition and illustration of each spectral class and of many of their subdivisions, presented in brief but very convenient form.

The three volumes are worthy additions to a long line of predecessors whose characteris-

tics have become so well determined and so familiar that if title pages were removed and all reference to the authors deleted, no astronomer could be left in doubt as to the source from which they came.

George C. Comstock
University of Wisconsin

The Chemistry of Food and Nutrition. By Henry C. Sherman. Second edition. New York, The Macmillian Co. 1918.

This well-known text-book has been rewritten and presents modern knowledge upon the subject of nutrition in an exceptionally clear and readable form. The chemistry of foods is described, then the digestion and metabolism of the different food-stuffs. The review of the subject of the "vitamines" and of "growth hormones" is excellently handled and nowhere have these "accessory factors" in nutrition been more clearly defined. Sherman's long experimental studies of the salt metabolism and especially the calcium metabolism give authority to his discussion of the inorganic food-stuffs. The chapter on the dietary standards and economic use of food is of an order of excellence which has never been surpassed. Sherman's experience, based upon his own painstaking researches into the dietary habits of the poor classes of New York City, conducted for the New York Association for Improving the Condition of the Poor, leads him to declare that "the most frequent deficiency in American dietaries is inadequacy of the total food or energy value and most dietaries actually observed are of such composition as would furnish enough of each essential element if the total amount of food eaten were sufficient to provide a liberal energy supply."

Sherman clearly sets forth the principles of a sufficient and economical dietary in such a manner as to bring to mind the really great progress in the science of dietetics which has taken place in the last decade. This excellent and thoroughly scientific treatise upon nutrition should be in the hands of all who are interested in the food question, both as it appears now and as it will shape itself after the war. It is a pleasure to note that the author has been unusually conscientious and generous in giving credit to the work of others.

Graham Lusk

SPECIAL ARTICLES

THE FORMATION OF THE FAT DROPLETS IN THE CELLS OF TISSUE CULTURES

Experiments of Daddi (1896)[1] and more particularly those of Riddle (1910)[2] show that Sudan III., fed to animals, is taken up by fat in the intestine, passes through the intestinal wall in combination with fat, and is deposited in the body cells in the form of red fat globules. These observations suggested a method for testing out the question as to whether or not the mitochondria form the fat droplets. If Sudan III. remains attached to the fat, as Riddle seems convinced it does, and the cells store up this Sudan III. fat, the question arises, is the Sudan III. fat deposited in the mitochrondria before appearing as red fat globules in the cytoplasm? If such were the case, we should be able to find traces of the Sudan III. in the mitochondrium, at least during the final stages in the formation of the fat droplet, but this could not be done, and as will be seen below, the mitochondria take no part in the formation of the fat droplet under such conditions.

The yolk of a hen egg was mixed with Sudan III. until it became red. A small quantity of this red yolk was then diluted with Locke-Lewis solution and placed on a number of twenty-four-hour cultures of 6–9-day chick embryos (Lewis and Lewis method). Certain of the cells were then selected and their unstained fat droplets noted and drawn. Each of these cells was carefully followed for the next few hours, or until a number of fat droplets had appeared in the cytoplasm. These took the form of exceedingly small, reddish-yellow droplets, often far removed from any

1 Daddi, L., "Nouvelle méthode pour colorer la graisse dans les tissues," *Arch. Ital. de Biol.*, 26, 1896.

2 Riddle, O., "Studies with Sudan III. in Metabolism and Inheritance," *Jour. Exper. Zool.*, 8, 1910.

mitochondrium. The mitochondria at no time contained any orange-colored droplets or any droplets at all. Neither did they become rounded, loop- or ring-shaped. As a matter of fact, they behaved in a manner quite like what has been described as normal for the cells of tissue cultures (Lewis and Lewis, 1915).[3] Once a loop-shaped mitochondrium was seen, but this unbent and became a thread again without the formation of any globule. The very small orange-colored droplets unite into larger ones, others appear in the cell, and thus in the course of five or six hours several additional fat droplets of different sizes can be seen. While this process is going on, the fat droplets previously noted and drawn take on a bright orange stain, so that in a very short time it is impossible to distinguish by means of color those droplets which were present in the cell before the addition of the Sudan III. yolk. The color exhibited by the fat droplet in the living cell, while a bright yellowish-red, was never the same shade as that obtained in a culture fixed and stained with Sudan III. Nile blue sulphate could not be used in these experiments because as has been previously shown, it stains bodies that are not fat in the living cell. The fat droplets of the mesenchyme cells remain distinctly smaller than those of the clasmatocyte. Neither the mesenchyme cell nor the clasmatocyte were ever observed in the process of engulfing a yolk globule. It is doubtful whether either type of cell ingests fat in tissue cultures.

Certain of the cultures, which when living contained no loop- or ring-shaped mitochondria, after the application of different fixatives contained in varying numbers swollen, varicose and ring-shaped mitochondria according to the method of fixation employed. The question of fixation is necessarily quite different in these cultures, since most of the cells are spread out in a thin layer unprotected even by plasma from the direct action of any chemical placed upon them. Nevertheless since certain forms of mitochrondria were shown in these cultures to be the result of the method of preservation, it would certainly seem probable that these same shapes observed by other investigators (Dubreuil, 1911[4] Guilliermond, 1913),[5] were obtained in the same manner.

In the above observations there was no need to resort to fixed preparations, as all the structures of the cell were clearly seen, and the bright orange-colored droplets could be followed without fear of confusing them with the easily distinguishable mitochondria. The fat droplets accumulated in the living cell without being associated at any time with the mitochondria and without any changes taking place in the shape of the mitochondria such as have been claimed by other observers (Dubreuil 1911,[4] Russo 1910,[6] etc.).

MARGARET REED LEWIS

THE AMERICAN MATHEMATICAL SOCIETY

THE twenty-fifth summer meeting of the society was held, by invitation, at Dartmouth College, Hanover, N. H., on Wednesday, Thursday and Friday, September 4–6, 1918, connecting with the meeting of the Mathematical Association of America, which began on Friday morning. The joint dinner of the two organizations, on Thursday evening, was attended by fifty-six members and friends, who were greeted by Dean Laycock in the name of the College. At the joint session on Friday morning Professor A. G. Webster gave an address on "Mathematics of warfare."

The college dormitories were opened for the accommodation of the visitors, and meals were served in the commons. Headquarters and general gathering place between the sessions was provided in College Hall, where an informal reception was held on Wednesday evening. A letter of welcome from Business

[3] Lewis, M. R., and Lewis, W. H., "Mitochondria and other Cytoplasmic Structures in Tissue Cultures," *Amer. Jour. of Anat.*, 17, 1915.

[4] Dubreuil, G., "Les nitrochondries des cellules-adi peuses," *Compt. rend. Soc. Biol.*, 1911.

[5] Guilliermond, A., "Sur les nitrochrondries des champignons," *Compt. rend. Soc. de Biol.*, 1913.

[6] Russo, A., "Sui mutamenti che subiscono i mitochondri ed i materiali dentoplasmici dell oocite di coniglia in diversi periodi di inanizione," *Arch. f. Zellf.*, 4–5, 1910.

Director Keyes tendered the hospitality of the college to the two societies. Excursions into the country about Hanover were arranged for the closing days of the meetings. At the joint session a vote of thanks was extended to the college authorities for their generous cooperation toward a successful occasion.

The meeting of the society included an evening session on Wednesday and the usual morning and afternoon sessions on Thursday, besides the joint session on Friday morning. The attendance included forty-six members. Professor W. W. Johnson presided at the Wednesday session, and Professor H. W. Tyler at the Thursday sessions. The following new members were elected: Professor A. L. Candy, University of Nebraska; Mr. J. R. Carson and Mr. R. S. Hoyt, American Telephone and Telegraph Company; Dr. K. W. Lamson, Columbia University; Professor A. S. Merrill, University of Montana; Mr. F. H. Murray, Harvard University; Mr. H. W. Nichols, Western Electric Company; Professor W. E. Patten, Government Institute of Technology, Shanghai, China. Nine applications for membership were received.

The following papers were read at this meeting:

L. B. Robinson: "A curious system of polynomials."

G. A. Miller: "Groups generated by two operators whose relative transforms are equal to each other."

P. J. Daniell: "Differentiation with respect to a function of limited variation."

B. F. Groat: "Models and hydraulic similarity."

L. C. Mathewson: "On the groups of isomorphisms of a system of abelian groups of order p^m and type $(n, 1, 1, \ldots, 1)$."

C. N. Reynolds: "On the zeros of solutions of linear differential equations of the fourth order."

J. E. Rowe: "Related invariants of two rational sextics."

W. W. Johnson: "The nature and history of Napier's rules of circular parts."

O. E. Glenn: "On a new treatment of theorems of finiteness."

Louise D. Cummings: "The trains for the 36 groupless triads on 15 elements.

Josephine R. Roe: "Interfunctional expressibility problems of symmetric functions (third paper)."

B. F. Groat: "Equations of the elastic catenary."

C. H. Forsyth: "Relative distributions."

W. D. Cairns: "A derivation of the equation of the normal probability curve."

Mary F. Curtis: "Curves invariant under point transformations of special type."

G. D. Birkhoff: "On stability in dynamics."

Daniel Buchanan: "Periodic orbits on a surface of revolution."

A. R. Schweitzer: "On the iterative properties of an abstract group (third paper)."

C. N. Haskins: "On the roots of the function $P(x)$ associated with the gamma function" (preliminary communication).

Christine Ladd-Franklin: "Bertrand Russell and symbol logic."

Abstracts of the papers will appear in the secretary's report in the November *Bulletin*.

The next regular meeting of the society will be held at Columbia University on Saturday, October 26.

The society has recently published Part I. of Volume V. of its series of Colloquium Lectures being the lectures given by Griffith C. Evans on "Functionals and their applications: selected topics, including integral equations" at the Cambridge Colloquium, 1916.

F. N. Cole,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

Friday, October 25, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE TRAINED MAN OF SCIENCE IN THE WAR[1]

The motto of our society, as our newly initiated members now know, is one by following which unconsciously they have won admission to it: "The love of learning is the guide of life." It must have occurred to you all to ask how can this assertion be true in times like these. That an answer may be given easily is evident if we remember the circumstances under which the society was founded, at the College of William and Mary, in the midst of the Revolution. Our ancestors were engaged in a struggle for the freedom of the individual, the freedom of the soul; so are we to-day. They had entered this entirely unprepared; so did we. They were faced with difficulties which seemed at times unsurmountable; our obstacles to victory are no less formidable. The Phi Beta Kappa Society owes its origin to a recognition on the part of its founders and supporters of two great facts: the importance to the individual of the love of learning and the responsibility resting upon him as an educated man to serve his country.

I think it is only fair to say that the universities of this country have played their part well. Before we actually entered this war, in those anxious years when we were waiting to see whether we would be given an opportunity to join in the fight for the cause of honor, freedom and the teachings of Christianity, or whether we must walk through the years of our lives with heads hung in disgrace, no group of people did as much to hold aloft the illuminating torch, revealing the iniquity of the enemy of civilization, as did the presidents of our universities. Theirs will be the honor forever. They would not keep silent. Then, as soon as we were by official act in a state of war, the first to step forward and say "use

[1] Annual address before the Phi Beta Kappa Society, University of Virginia, 1918.

me" were the faculties and the student bodies. It was indeed a sight which brought tears to the eyes, and even further, to see our young men, the chosen men of our land, struggle against all restraints, eager to bring to an end that evil thing which threatened to destroy all the joy of life, all that made life worth living. Every teacher has felt thrilled by the daily farewells of his students, as one by one has obtained permission, by fair means or otherwise, to enlist in the grand adventure. We men associated with universities may well be proud.

Think for a moment what unutterable shame would have been ours if we had not acted with such certainty and such promptness. Every privilege brings its responsibility. It is a privilege to acquire an education and to share in imparting one. The country as a whole has grown to recognize this, and to look to the universities and to men trained in universities for advice, if not for guidance. It is the privilege of being a young man to-day, a college man or not, to be a soldier in the cause of civilization and to help bring victory to its colors; and what a glorious privilege this is! But upon whom rests the duty of interpreting events and their causes in language so clear that every man understands? Surely, upon the university man. And, when victory is won and men can give their minds to thoughts of safeguarding the world, there is no one to guide them but the students of history and of political science. It would be a simple matter to show how a special and particular responsibility has already come to and will continue to remain with each and every university group of scholars. I can speak with more definite knowledge of the relation borne by various branches of science with the war; and it is to this feature that I shall confine myself to-night.

A recent writer has alleged that the study of science at the expense of morals in German universities has led to this war. This is a bitter charge, but it is supported only by fallacies. Macaulay, in his brilliant essay on Dryden, shows, by a series of striking illustrations, how little is the influence upon the age of any individual, or any special group of individuals, when compared with the influence of the age on the man or group. When the time is ripe, the idea is born; the special man who reveals it is immaterial. So it is to-day, no one man, no particular department of thought or study can be held responsible for the present conditions in Europe. It is no more fair to say that the pursuit of science perverts character than to assert that the study of morals results in ennobling it. This war is due to a gradual debasement of character and nothing else, and the cause is to be sought in the will of the leaders of Germany.

One reason why science has been thought of as the scapegoat is because it was so evident from the very beginning of the war that Germany had mobilized for the purpose of war all her men of science, and was using the fruits of their investigations in ways entirely unexpected. This was a matter of great surprise to most Americans, and illustrates clearly the comparatively insignificant position held by scientific men in the minds of our people. This feature of Germany's long preparation for war, and of her manner of waging it was recognized instantly; and preparations to combat it were made promptly by all the allied peoples. Fortunately for us, the essential advantages were all with the French and British, inasmuch as their men of science had for nearly a generation been the ones who had given to the world its great discoveries and their most important applications. So their scientists came to the problems with ideas and methods which in many cases far surpassed the power of Germany to equal. The result was instantaneous; and to-day the efficiency of the forces of the Allies on the sea, on the land and in the air is due in no small degree to the men whose previous lives had been devoted to the pursuit of the pure sciences in university laboratories.

When this country entered the war, it is true beyond any doubt that the American people had great expectations, nay a conviction, that with our so-called inventive genius we would seriously influence the war, perhaps stop it, by the epoch-making inventions which our professional, highly advertised, inventors

would quickly make. The newspapers helped in fostering this belief, and many were the proud boasts which we heard. There was a great disappointment, almost a shock, as the days went by, the periods promised for great accomplishment passed, and certain names almost disappeared from the public press. We have in fact stopped asking what has happened to the "wizards." The reason is that the problem of this war is not to perfect an old device, but to design a new one; the knowledge required is not that of the amateur or even of the trained engineer, but definitely that of the scientific investigator, the man who by his own laboratory investigations has added to our store of knowledge. One illustration of this may suffice; one government board, with whose activity I am familiar, has had submitted to it in the course of the year 16,000 projects and devices, proposed by so-called inventors; of these only five had sufficient value to deserve encouragement. I have nothing but admiration for these 15,995 men, whose disappointment must have been keen. Most of them were more than willing to give their inventions freely to the government. The point I wish to emphasize is that the ability and knowledge required in waging this war successfully are not those possessed by any body of men except those with a profound knowledge of science and of scientific method. The problems are too complicated. It is true that with the help of trained technical men we will get better engines, better explosives, better guns; and for these we should be truly grateful to our much-boasted American genius. But, consider a problem like this: to devise a light signal, which can be used by day or by night, and which will be absolutely invisible to the enemy. Who can solve that? The answer is obvious: only a physicist.

In times of peace, when commercial development is uppermost in men's minds, the university scholar is at a great disadvantage. He rarely knows what problem is to be solved. He is busy with his own studies and researches, and does not come in contact, in the ordinary course of his life, with the demands of the technical trades. His discoveries are made use of, and are always—sooner or later—of commercial value; but in this later stage he does not take part. Nearly all of our great technical companies maintain extensive laboratories where trained men pursue investigations in pure science; but problems are rarely given them to solve. To-day, in order to meet the insistent demands of the war, the whole process is changed. On every battle front of Europe, attached to the various staffs, are men from university faculties, skilled in observing, quick to learn what is needed. In Paris, London and Rome there are groups of university men whose duty it is to collect data from the Allied powers along similar lines. Reports containing clear statements of the problems are cabled to Washington. To this same center come requests for help from our own forces on this side of the ocean. Then, as soon as the problem can be formulated with definiteness, one or more men are asked to find the solution. For the first time in the history of science, men who are devoting their lives to it have an immediate opportunity of proving their worth to their country. It is a wonderful moment; and the universities of this country are seizing it. The stimulus to scientific work is simply enormous; and the growth of our knowledge is astounding. In many cases investigations are prolonged for months, and in the end possibly the much desired solution is not obtained; but in any case new methods are made available for future use, new instruments are perfected, and the store of human knowledge is vastly increased. Let me give one illustration of this reaction of the demands of war upon pure research. In the construction of a mask to be used in case of a gas-attack it is obvious that one method of defense is to make use of charcoal which is known to absorb many gases with great rapidity. A scientific problem was to try to increase the efficiency of this absorbing action; and it was soon discovered that by a special treatment of charcoal made in special sizes from special wood the absorptive power could be increased enormously. Here is a fact of the greatest importance to the chemist, a fact which will be remembered in countless investi-

gations of the future; and yet it is doubtful if it would have been discovered for many years to come if a particular chemist had not been asked by the military officers to help them.

As I trust you have already discovered, my thesis to-night is the importance of the work of the trained man of science in this war, with emphasis upon the fact that his great usefulness should not be a matter of surprise, as it is to most Americans. The best way of demonstrating this is to give a few illustrations, chosen from a wide field and not limited to the scientific work of any one country. Naturally I can refer only to those matters which have been revealed to the public; but I trust that many of them will be new to this audience. I have this confidence because so far the newspapers of this country have not believed that these questions would make what is called a "story."

It is not easy to make a selection of the scientific problems, nor to arrange them in any logical order. There are two subjects uppermost in the minds of every one: the airplane and the submarine. The scientific questions which have arisen in regard to each are most varied. The airplane itself is an engineering structure; and we have confined ourselves in this country largely to the design and production of an engine. This does not really come under my general subject, but every one is so interested in it that I feel justified in referring briefly to what we have done. Our task was to produce on a great scale a powerful, efficient engine. This is now being done. The so-called Liberty 12-cylinder engine does not have its superior in the world, and further, it was so designed that it could be manufactured on an enormous scale, at least 1,500 a month. This engine has over 400 horse-power and weighs close to 800 pounds, and therefore it is useful for seaplanes, two-seater machines and bomb-droppers, but not for small machines. When the same engine is made with 6 cylinders, developing about 220 horse-power, and weighing about 400 pounds, we will have an ideal engine, not equalled by any now in existence, for speed scout machines. We could not have followed any plan more useful to ourselves and the Allies than to make this concentration of effort. Our eminent success is a cause of pride to every American. With regard to the airplanes, considered apart from their engines, a few statements of fact must suffice, but they are facts. The best airplanes in service to-day, for each and every purpose, are those of British and French design. This is the result of real scientific investigation. The resistance offered by wings of different sections, the stability of the airplane, the character of the covering surfaces have all been investigated, and the finished product is the result of the knowledge thus acquired. We are doing similar scientific work in this country to-day, and, as we have engineers and manufacturers unsurpassed in the world, the time is not long distant when a truly American airplane will be made. We shall suffer, however, one serious detriment during the war; we are so far away that it will be extremely difficult for us to make the alterations in design which the varying conditions of modern war impose. Difficulties of transportation are great, and it is a serious question whether it would not be best for us to remove bodily our most important airplane shops directly to the Continent. From a scientific standpoint the most important questions arising in connection with airplanes are instruments of navigation and methods of signalling to and from the ground and each other Each machine should have for ordinary flights an instrument to indicate height above the ground, another to give the speed of flight through the air, another to tell how steep is the ascent or the descent, and many others. For long-distance flights a compass is necessary, and other instruments as well. The design of each of these is a distinct scientific problem. Think of the requirements for a compass to be used with an airplane; for a ship on the ocean the problem is complicated, but how much more so for a vessel which turns rapidly, revolves in spirals, and which practically never keeps a constant course. In practise even more difficulties arise. The whole question of airplane instruments is still unsettled to a certain extent; many essential instruments have not as

yet been designed, and improvements are needed in them all. Scientific men in all countries, including our own, have the matter under study; and the results so far accomplished are truly wonderful. In the use of airplanes for observation purposes, or in squadron formation in making attacks, it is essential for the men in the machine to communicate with the ground. Many systems are in use, involving the application of light signals, wireless telegraph, etc. Obviously the proper instrument would be the wireless telephone, and that is surely coming, and soon it will be possible for one pilot to talk with another or with the commanding officer on the earth; and the latter can give orders to all of his machines in the air. The objection to the use of all forms of wireless apparatus, telegraph or telephone, is that the enemy may confuse the signals by using the same wave-length for his disturbing impulses. This may be prevented however. Under the demands of the modern army, all forms of wireless have been so perfected that the progress made is a source of surprise and wonder. In fact there have been made in this country certain modifications and improvements which are held rigidly secret. It is interesting to note that every one of these alterations in wireless operation was first worked out in physical laboratories, by trained physicists. Bomb dropping as practised to-day is not a scientific operation; there are too many variables. In spite of this, though, the accuracy of hits is increasing daily; and new processes are being developed. When it is seen that one method can not be made accurate, the next step is to devise one that will be. It will not be long before all the countries in the war will realize the fact that the tactics of fighting in the air are essentially unique, and there will be a land-service, a sea-service and an air-service. Both the army and the navy need airplanes for their operations; but after their demands are supplied, there remains the wide expanse of the air through which attacks can be made upon the enemy, far away from the battle-front and the coast. Great Britain has recognized this all-important fact, and is building a great fleet of airplanes for this new service. In this, new instruments, new types of machines, new guns and bombs are required.

There are two main problems in connection with the submarine, first to locate it, second to destroy it. Methods of destruction are at hand in the shape of depth bombs; but methods of detection so far have not been eminently successful. From an airplane one can see through the water only to a limited depth, never more than twenty feet, and so the main reason why the seaplanes have been so successful in destroying submarines is not due to the fact that the observer in the airplane discovers his prey, but is that his machine has such great speed, three times that of a destroyer, that when news is flashed that a vessel is being attacked by a submarine it can often reach the spot in time to drop its bomb effectively. The detection of the presence of a submarine is a definite physical problem; and it is not an exaggeration to say that at least one fourth of the physicists of note in England, France and this country have been engaged in the attempt to solve it. What lines of attack upon it are open? Not many. The submarine in motion emits certain sounds; can they be heard? It is a solid body; can one obtain an echo from it? It is made of iron; can this fact help through some magnetic action? These are the obvious lines of approach, but one should not hastily conclude that there are not others. Without stating, and I may not, how far successful these efforts of the physicists have been, I may note that the method which is now being tested by our Navy is one elaborated by a distinguished professor of mathematical physics. In the course of these extremely numerous experiments upon the submarine question several beautiful methods have been developed which after the war will have great scientific importance; one of these, due to a French physicist, is one of the most interesting developments in physics made within a decade. Another submarine problem, which is by no means of secondary importance, is to develop a method by which one submarine may communicate with another or with the shore. I do not think I

am saying too much when I state that this has been solved, even for considerable distances.

Closely associated with the airplane and the submarine is the balloon, either a dirigible or an observation one. The great problem here is to find a means of inflating it with some gas which is non-inflammable. Hydrogen is now used in general; and, when a balloon is brought down in flames, it means that the hydrogen has caught on fire. This problem is partly physical and partly chemical; and numerous experiments are now in progress, all being directed by university men.

I can not leave the subject of the airplane and the observation balloon without referring to the question of maps and map-making, in connection with which the former are so important. Until one has been at the headquarters of an army, it is not possible to realize the extent to which maps are used, or the various types of maps required. There are maps showing roads, paths and trenches; maps for staff officers, for regimental commanders, for company captains, for sergeants; there are maps showing the position of the enemy's ammunition dumps, aerodromes, signal stations, anti-aircraft guns; there are maps showing the location of the enemy's batteries; there are special maps for the use of the quartermaster, etc., showing where each horse trough, each well, each storehouse is. Map-making has long been a function of engineers; and in this war the most marked improvements have been in the main mechanical, first in introducting quickly on a map the revelations made by aerial photographs, second in increasing the speed of production of a map. In many cases, entirely new sets of maps are made each day, each one containing the information obtained within the preceding twelve hours.

Another department of science closely connected with airplanes and balloons is meteorology. We associate this word with weather prediction and with uninteresting data; but it must be remembered that these data include observations of temperature, of moisture content of the air, of air pressure, of wind direction and velocity at different heights above the earth. A knowledge of all of these is absolutely essential for each day's battle. Artillery at a long range is useless unless the temperature, the moisture content and the wind are known accurately. Gas attacks are controlled by the knowledge of winds and barometric pressure. The safe strata for airplanes must be known; and for long distance work weather prediction of every description is essential. So important is the subject that observation stations with competent forecasters and scientific observers dot the battle-front at close intervals; and the home offices send almost hourly reports to the fleets and the coast-stations. What strikes a layman most forcibly when inspecting a meteorological station near the battle-line is the rapidity of operation. Only minutes lapse between the observations and the deduction of the conclusion. One realizes then how much meteorology has grown into an exact science.

Modern artillery is a good illustration of the application of pure science. All of us are now familiar with the method by which artillery fire is controlled by the aid of airplanes; but you may not realize its wonderful accuracy. If the enemy's battery is located, by any means, this implies that its position on a topographic map is known to within, say, fifty feet, often less. It may be at a distance of ten, fifteen or more miles. Then to hit it, an exact knowledge of the properties of the powder used and of ballistics is required. With this, the target is reached in an astonishingly short time. I have witnessed myself the destruction of a German battery at a distance of eleven miles by a French battery of three thirteen-inch guns, all done within ten minutes, the exact aim being secured after three salvoes. The perfection of the mechanism of the French 75 and 87 millimeter guns is known to us all; but we hear much less of the English and American guns. I can assure you that this is only a curious bit of camouflage. Of all the numerous ways in which physics has been called in to assist artillery, I known none so interesting as is illustrated by anti-aircraft gunnery. The problem is most difficult. An airplane may be traveling at a

speed of 100 or 10 miles an hour, it rarely keeps a constant course, it may be at a height above the earth of 20,000 feet, nearly four miles. The man aiming the gun must know the position of the airplane and its speed, and then must make his calculations so that when his shell reaches the immense height, it shall be so timed as to meet the airplane. It is true that it is rather a question of the airplane meeting some fragment of the shell, than the converse; but the problem is the same. When it is realized that numerous hits are recorded at heights of 20,000 feet, and when one hears the personal experiences of the pilots, it is clear that the problem has been solved fairly well. A former student of mine writing to me a few days ago, after telling how he had "speared his first Hun" on his first day at the front, added that the German shells rarely missed him by more than ten feet, and he was flying a rapid scout machine and was manouvering for position all the time. I am familiar with the French and British methods of aiming their guns; and, as you can yourself decide from reading the newspapers, they are not inferior to the ones used by the Germans.

One can not speak of artillery without thinking of gas shells and gas attacks. The Germans were the first to use this hideous means of warfare, although it is well known that it was proposed to the British war office many years ago and the decision was reached that it should not be adopted. When poisonous gases first became a weapon, it was in the form of gas clouds, rolled along the ground by the wind, the gas having been released from cylinders in the front line of trenches. For perfectly obvious reasons this mode of gas attack was soon replaced by the use of large shells filled with the liquefied gas. When the shell was exploded by a contact- or a time-fuse, the gas would escape and work its action in all the neighborhood. There are two problems associated with this mode of warfare: an offensive and a defensive one. The former is to make a gas which can be liquefied, is not so light as to diffuse upward too rapidly, and which will either kill the man who breathes it or will in some way incapacitate him; the latter is to make a mask or a suit of clothing, if necessary, which will enable the wearer to breath and do his work in the contaminated atmosphere. We hear most of course about the terrors of the gases used by the Germans; but, if they would only describe to us their feelings about the gases sent them, our point of view would change. Some might even have a feeling of pity. Both the questions, of defense and offense, are strictly scientific ones, in the main belonging to chemistry. The researches undertaken in Great Britain, France and this country are so numerous that the truth is almost unbelievable. It is safe to say that to-day there are at least 2,000 chemists in America alone working on problems connected with the military use of gas. We can well be proud of the achievements of our chemists. Among many things which I may say I shall select two: they have devised a mask for use inside a gun turret on our large ships where a particularly dangerous gas is liberated during a battle, and the masks supplied our soldiers are at least 20 per cent. better than either the British or French mask, and they are better than the German model. As another illustration of the usefulness of chemists in this war, one should state what has been done by them to render the allied countries and our own independent of Germany from an economic standpoint. All I shall do, however, will be to mention two subjects: dye-stuffs and drugs; and you know the rest. It should be remembered, though, that this is not the full story, only an interesting chapter.

One of the most important military questions, which in the end is a purely physical one, is that of signals. Our army is most fortunate in having as its Chief Signal Officer a man who is a doctor of philosophy in physics, from Johns Hopkins University, Major General George O. Squier. He certainly knows his subject from the scientific standpoint as few military officers can know it. Think for a moment of the variety of signals required. Those to and from airplanes and submarines have been referred to. In addition, each trench, each outpost, each reserve force,

each artillery battery must be in unbroken communication with the brigade headquarters, and the division and staff officers. Wireless telegraphy and telephone are used in various ways; ordinary telephones are installed everywhere: carrier pigeons must be bred and trained; signals using both sound and light are most useful. It is not merely a matter of perfecting signals which work satisfactorily; much more is required, safeguards must be devised which make it impossible for the enemy to observe or read them. When I say that all this has been done, and done to a large degree by our American physicists, I am telling only the bare truth. I wish it were permitted to tell more.

Signals as used by the Navy are not as varied as those required by the Army. But there is one special problem which concerns the American Navy more than any other. We are sending ships and transports to Europe in large groups, as you know, and at night no lights are shown by any vessel; the question then arises, how is it possible to maintain relative distances and positions? This sounds as if it were an almost hopeless proposition; but it is not; and I have seen a solution which seems satisfactory, again the ingenious idea of an American physicist.

The demands upon photography are great, largely in connection with airplanes; and the methods elaborated by the British and French scientists are beautiful. There are other phases, though, of almost equal importance. Can we not take photographs of objects which the eye can not see, owing to clouds, haze or distance? This matter is solved in a large degree as a result of our spectroscopic knowledge. By photographic methods it is possible to discover the location of the enemy's batteries unless they are hidden with the utmost care. In this last case resort is had, as you know, to what is called sound-ranging. When a gun ejects its shell in the direction of the enemy, the latter hears in succession three sounds; first that due to the passing of the shell through the air, in general a hissing sound; then the proper sound from the gun mouth, a boom; and finally the sound of the explosion of the shell. Sound waves travel through the air with a comparatively slow velocity, slightly over 1,000 feet per second, and so if observing stations are placed at different distances from the gun, any one type of the three sounds, *e. g.*, the boom, will be heard at different instants of time. It is easily seen, then, that methods may be devised by means of a system of triangulation, by which the location of the gun may be determined. The accuracy of the methods in use is so great that now within a few minutes after the firing of a gun its position is known definitely to within limits less the accuracy of the guns which are responsible for the destruction of the enemy's battery. This last limitation is due to an unavoidable variation in shells and their powder charges, and to variations in the atmosphere. This method of sound-ranging is simple in theory, but extremely difficult in practise, owing to vagaries of the wind and to the confusion caused by simultaneous discharges of guns. The former difficulty has been overcome by a brilliant British physicist; but, as you have probably seen in the papers, one of the ways used by the Germans to conceal the position of its big guns by which they were bombarding Paris was to discharge a dozen other guns simultaneously.

A somewhat similar problem arises in connection with determining the position of an airplane at night, or in cloudy weather. One inherent difficulty here lies in the great speed and great height of the airplane. Rumors have reached us that the British have found a method; but, whether this is true or not, the problem is not hopeless. The airplane in flight emits sounds, loud ones; with that fact as a basis, its detection is therefore certain.

I am not sure that any of you would of your own account think of astronomy as being a practical science; yet there has been found a definite usefulness for these disturbances on the sun, known as sunspots; and astronomers easily turn from calculations of the motions of comets, planets and satellites to those of twelve-inch shells and bombs dropped from airplanes. The instruments used by navigators on the sea and in the air when the flights

are long are essentially those invented and adopted by astronomers. In fact an American astronomer has perfected within the past few months an entirely new instrument for the use of navigators, an instrument which will mean a great deal to both our sea and our air force.

Another science which seems remote from war is geology, and yet it has proved not simply useful, but essential. The minute you realize that this war is concerned with trenches, dugouts, military mines, tunnels, water-supply, etc., you see that here the geologist must be summoned to help. He alone knows from his maps, made in times of peace, how to plan for any emergency requiring one to go below the surface of the earth.

There is a group of sciences, not physical, which has, in the end, the greatest responsibility in bringing victory to our arms. The men who are directing the work, in the laboratory and in the field, are university men almost without exception. This group includes experimental psychology, medicine and surgery and hygiene. The function of the first of these is to devise such tests that we may be reasonably sure that a man selected for a certain duty can perform it. As a simple illustration, think of an airplane pilot. It is not difficult to analyze his responsibilities and to state the qualities which he should possess; further it is not impossible to devise experimental tests which may be performed on the ground in order to see if he has these qualities or, if not, to see whether he can acquire them in a short time. Our aviation section of the army has equipped laboratories along these lines, and the results obtained are most interesting. Certain generalizations will undoubtedly be deduced, and the examination of candidates can proceed more rapidly. As soon as our military departments can be persuaded to recognize the fact that experimental psychology can in many, if not all, cases state definitely that a man with such and such reactions ought not to command a company, a regiment or a ship, our fighting forces will become efficient, not before.

The varied activities of our medical departments are known to you all. When I think of them, what is uppermost in my mind is their progress in combating disease. I may be pardoned for speaking of two illustrations. The gas-bacillus, the cause of hospital gangrene, has lost its terrors absolutely; first by the Carrel-Dakin treatment of wounds, second by Dr. Bull's discovery of a serum which may be used exactly as diphtheria anti-toxin is used. Dr. Carrel is a Frenchman and Dr. Dakin is an Englishman; but both have lived long in this country; and Dr. Bull perfected his method at the Rockefeller Institute, New York. My second illustration is the discovery of the means by which trench fever is conveyed from patient to patient. This is not a dangerous disease, but is one which renders soldiers non-combatants for the time being. This discovery has just been made in France by two of our American doctors, both attached in normal times to American universities.

Time fails me to speak of any more of the ever-growing number of ways in which the men of science of all countries are helping the military arms. But, if I were to stop now, I would leave unanswered one question which I know is in your mind. You are probably saying to yourselves, "Yes, this is interesting to hear about the scientific achievements of ourselves and the Allies; but what is the real use of it, when Germany, which leads the world in all branches of science, is our enemy?" Now, let me say at the very beginning that no educated man, certainly no member of the Phi Beta Kappa Society should assert that Germany is the leader of the world in science. It is true that Germany modestly acknowledges it, and every American newspaper supports the claim in ways both direct and insidious. The facts, however, do not support it. Many years ago it undoubtedly was true, but a full generation has passed since then. The Prussian form of government does not encourage individuality or freedom of thought; and these are essential for scientific discoveries and scientific development. In all seriousness I maintain that Germany has not been fruitful in ideas for many years in any of the experimental sciences, with the exception of medicine. In the fields of physics, of chemistry,

of meteorology, of metallurgy, you must look for the leaders in other countries.

It may be true, although I doubt it, that Germany has the best generals, the best guns, the best ships; she certainly has the largest army and the power to bear upon any point the greatest force; but this condition will pass. In the meantime there are two agencies at work in this country which in reality are most powerful sources of German propaganda. One of these is the interpretation given to news from the war by our public journals, and the emphasis placed upon German successes. In part this is due to the lack of realization by the managers of the papers of their responsibility in the matter, but in larger part to that policy of a newspaper office which leaves the writing of the headlines in the hands of unexperienced, comparatively uneducated, young men. The other agency of German propaganda, and a much more vicious one, is the policy adopted by our own government in regard to giving out official information. The whole policy is wrong, and should be changed. The people have lost confidence in the government agents, and rightly so; they are either optimistic to a ridiculous degree or boastful. What is required is that the government must realize the tremendous responsibility of the office charged with the dissemination of news. There is no man in America too great for this task. He must command the absolute confidence of every one; he must be able to speak the truth and *nothing* but the truth; he must understand the thousand phases of the war, looked at from a military, a medical, a scientific, a social standpoint; above all he must be allowed to give the American people real information in regard to the efficiency, the achievements of our people and of the Allies. It is absolutely impossible for a man trained as a newspaper writer to grasp the situation. It is one of the real tragedies of the hour that the American people are so often deceived and are not told the truth about so many matters which concern them so vitally. If our people could only realize the exact situation, Germany would lose half her power, because in fact the American people are afraid of her, a condition which is absurd.

The scientific men of America have suffered greatly at the hands of the people. As I said at the beginning of this paper, it was a matter of great surprise to the country that science had any part in this war. Even such men as the members of the engineering societies have been slow to recognize the value of the service of the investigators in science. The ablest group of scientists in America is naturally the National Academy of Sciences, and the physicists are associated in a large and powerful American Physical Society; yet, when a few years ago one of our government departments determined very wisely to form a board of professional scientific and technical advisers, neither of these national societies was invited to name a delegate or to participate in any way. It was not understood clearly why the American Mathematical Society was requested to name a member of this board until it was explained that it was thought it might be useful to have a man who could do figures for them. This was of course simply a case where the general ignorance of the country was crystallized in action.

The time has come for America to recognize the usefulness of the scholar, the thinker, the investigator of science. All the other countries of the world have done so long since. It is only in regard to such experimental sciences as physics and chemistry that there is this failure in this country to appreciate the services of its experts. If the question as to the prevalence of a particular disease in army camps is to be investigated, a board consisting of pathologists and men skilled in hygiene is selected almost automatically, not a board of practitioners. The same is true in regard to all questions of public health, of social questions, of law. It is the duty of all college and university men to make their voices heard and to bear witness to what their teachers and their associates have done and are doing.

To return to our motto; the love of learning is a good guide for life; it brings its own happiness, it makes one a useful citizen both in times of peace and in war, it prepares a man for that service which is our only justification for living.

J. S. Ames

The Johns Hopkins University

LIEUTENANT HERBERT DOUGLAS TAYLOR

Lieutenant Herbert Douglas Taylor, M. C., U. S. Army, associate in pathology and bacteriology of the Rockefeller Institute for Medical Research, died on October 7, 1918, at the age of thirty.

Lieutenant Taylor was a graduate of St. Johns College, Annapolis, Maryland, and received his degree in medicine at the Johns Hopkins Hospital in 1914. During the three and one half years of his association with the Rockefeller Institute, he had made many important studies and published several papers especially relating to malignant tumors, tuberculosis and bio-chemical problems involved in the safer and more effective use of antiseptics in military surgery. Dr. Taylor was one of the group of younger workers at the Rockefeller Institute who at large personal sacrifice have chosen the pathway of research and in the emergencies of war have bent every energy to practical medical aspects of military service. Commissioned as first lieutenant soon after the entrance of this country into the war, he gave himself without reserve to the instruction of medical officers of the U. S. Army and others at the War Demonstration Hospital and in the Institute Laboratory courses, in those phases of scientific medicine of which he was master.

In the course of his duties at the hospital he apparently became infected with influenza with the immediate supervention of pneumonia, from which he died on the third day. He was a man of lofty ideals, of boundless enthusiasm in his tasks and an inspiring comrade.

T. M. P.

SCIENTIFIC EVENTS

APPOINTMENTS AT THE NEW YORK STATE COLLEGE OF AGRICULTURE AT CORNELL UNIVERSITY

At the New York State College of Agriculture at Cornell University Ezra Dwight Sanderson has been appointed to be professor of rural organization. He was graduated from the Michigan Agricultural College with the degree of bachelor of science in the late nineties. He spent a brief time immediately after graduating at Cornell as a special student in entomology and for some years thereafter was engaged in entomological work in Delaware, Texas, and New Hampshire. In 1907 he was made director of the New Hampshire Agricultural Experiment Station, which position he held until 1910 when he left to become dean of the College of Agriculture of West Virginia University and director of the West Virginia Agricultural Experiment Station. In June, 1915, he resigned the latter position to enter the graduate school of the University of Chicago as a student in sociology and he was subsequently made a fellow in sociology at the University of Chicago. He is a member of the Society of Sigma Xi, one time president of the Association of Economic Entomologists and fellow of the American Association for the Advancement of Science. His work at Cornell will lie broadly in the field of rural social organization. This is the beginning of definite provision at the State College for the social problems in country life.

Homer C. Thompson has been appointed to be professor of vegetable gardening. Professor Thompson was graduated from the Ohio State University with the degree of bachelor of science in horticulture in June, 1909. Prior to this he had been employed in the United States Department of Agriculture in experimental gardens and had charge of experimental work on rice lands in South Carolina. During his last year in college he held the position of assistant in horticulture and subsequently held positions as assistant horticulturist in the Mississippi Experiment Station and assistant professor of horticulture in the Mississippi Agricultural College and professor of horticulture at Clemsen College, South Carolina; in 1911 he was appointed assistant horticulturist in the United States Department of Agriculture, and in 1912 was given charge of the truck crop production projects of the department and he has had responsibility for them since that time. In 1913 he was promoted to the position of horticulturist in the United States Department of Agriculture. Professor Thompson has had opportunity to study the production of vegetables in prac-

tically all sections of the United States and has directed the government's experimental work on truck crop production and storage. He has published a number of government bulletins in his field. He is a member of the American Association for the Advancement of Science, the Society for Horticultural Science and the Botanical Society of Washington.

THE INFLUENZA EPIDEMIC

The Bureau of the Census supplies the following information concerning deaths (still-

City	Estimated Population July 1, 1917[1]	Death Rate Week Ending Oct. 12[2]	Deaths from Influenza During Week Ending					Deaths from Pneumonia (All Forms) During Week Ending				
			September			October		September			October	
			14	21	28	5	12	14	21	28	5	12
Albany	106,632	37.7					34	2	0	2	2	11
Atlanta	196,144	21.8					5	7	a	4	7	25
Baltimore	594,637	69.5				30	192	7	6	19	87	371
Birmingham	189,716	22.3						3	a	2	12	30
Boston	767,813	87.3	19	172	600	991	850	27	93	175	225	177
Buffalo	475,781	37.6				7	82	8	11	16	41	98
Cambridge	114,293	66.2			82	113	100	7	4	23	27	15
Chicago	2,547,201	33.7			17	171	571	15	24	74	240	476
Cincinnati	414,248	24.4				3	47	5	4	6	15	20
Cleveland	691,251	14.2				3	18	5	8	10	15	22
Columbus	220,035	23.7					15	1	4	6	10	13
Dayton	128,939	24.3					20	2	1	2	5	11
Denver	268,439	21.2						3	3	8	19	a
Fall River	129,828	100.4				86	192	0	5	6	11	a
Grand Rapids	132,861	11.8						2	a	1	3	a
Indianapolis	283,119	23.0						3	6	10	24	a
Jersey City	312,557	52.9				16	87	2	6	21	b	a
Kansas City, Mo.	305,816	28.3				26	75	5	a	10	11	a
Los Angeles	535,485	14.9						9	a	2	14	a
Louisville	240,808	36.8						3	0	4	14	a
Lowell	114,366	89.8			16	29	37	1	8	16	64	104
Memphis	151,877	43.3					13	a	a	a	a	67
Milwaukee	445,008	19.7					15	4	5	13	15	54
Minneapolis	373,448	17.5					37	2	a	11	13	a
Nashville	118,136	78.6						2	a	3	5	29
Newark	418,789	37.1				31	119	a	a	a	a	70
New Haven	152,275	41.8			11	30	68	0	2	4	6	a
New Orleans	377,010	36.7				12		5	a	3	17	a
New York	5,737,492	30.1				299	979	74	98	145	434	1,642
Oakland	206,405	11.9						4	0	2	3	a
Omaha	177,777	27.3						1	a	2	7	a
Philadelphia	1,735,514	97.2				399	1,697	20	32	76	307	938
Pittsburgh	586,196	30.2						12	17	a	a	a
Portland, Oreg.	308,399	7.4						4	a	8	3	a
Providence	259,895	52.4				61	125	4	10	20	37	57
Richmond	158,702	58.5						4	2	3	a	a
Rochester	264,714	21.7					14	1	1	7	6	22
St. Louis	768,630	15.9					40	12	13	20	25	46
St. Paul	252,465	19.0					31	3	a	3	1	a
San Francisco	471,023	14.6						6	14	15	15	a
Seattle	366,445	17.9					54	4	2	4	a	a
Spokane	157,656	8.9						2	a	1	1	a
Syracuse	158,514	90.1			38	125	216	0	a	b	14	3
Toledo	202,010	16.5					2	2	0	5	3	7
Washington, D. C.	369,282	86.7			12	116	387	10	a	17	57	101

[1] Populations have been estimated by the arithmetical method. Owing to recent unusual migrations of the population and to the fact that 1917 is far away from the last census year, the estimates are probably too high in some cases and too low in others.

[2] These rates represent annual rates per 1,000 estimated population. [a] Not reported.

births excluded) reported during the week ending October 12, 1918, with death rates, in large cities of the United States, together with the number of deaths from influenza and pneumonia occurring in the course of five weeks.

THE BALTIMORE MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE meeting of the American Association for the Advancement of Science and of the national scientific societies affiliated with it, which it has been planned to hold this year in Boston has been transferred to Baltimore in order to reduce as much as possible the need for traveling and to be near Washington, which has become the center of scientific activity of the country. It is planned that the programs of the association and of the affiliated societies shall be mainly directed to questions of national welfare, national efficiency and national defense; they will demonstrate the value of science and of the work of scientific men to the country in the present emergency. It may be expected that through conferences which at the time can not be made public, direct contributions will be made that will be of service in the conduct of the war.

Dr. L. O. Howard, the permanent secretary of the association, under the date of October 16, addressed the following letter to the secretaries of the affiliated societies.

Something of a complication has arisen in connection with the meetings of the American Association for the Advancement of Science and the affiliated societies:

The Johns Hopkins University has taken on the Students Army Training Corps and, therefore, its courses are largely revised and its faculty is very busy. Their Christmas vacation runs only from the 22d to the 29th of December, both dates inclusive.

I had expected to be able to utilize the facilities of Goucher College, but this institution has now been closed by the epidemic of influenza and will probably have to be in session during Christmas week.

The present situation leaves for our meeting dates the 23d and 24th (then comes Christmas Day) and the 26th to the 28th, these being the only dates in which certain of the lecture rooms of Johns Hopkins can be used by us.

The committee on policy of the association has decided to adhere to its decision to meet in Baltimore, but there must be some change in plans, both on account of the small size and number of lecture rooms available and the fact that there are practically no hotel accommodations. Members will have to rely almost entirely upon lodging-houses, hence it becomes practically necessary that the meeting be a small one, but we will go ahead and do what we can.

With this understanding, will you please let me know if you still wish to meet in Baltimore and whether, in your opinion, you can make your meeting a small one devoted largely to immediate problems? And then, will you let me know so soon as possible the number and size of rooms you will need and everything which should go into the program? Please let me know also the dates which you will choose for your meetings.

It is obvious that for certain of the affiliated societies the 23d and 24th should be selected and, for others, the 26th to the 28th, since rooms vacated on the night of the 24th can be used by members of the affiliated societies meeting on the 26th to the 28th.

It is planned to have the opening meeting of the American Association on the night of Thursday, December 26, although meetings of the sections may be held during the day of the 26th.

I shall be glad to hear from you speedily as practically the whole arrangements for the meeting will be in the hands of this office since we can not place any of the burden on the Johns Hopkins' people under the present circumstances.

If you have some good member of your society resident in Baltimore to whom you wish to entrust your special arrangements, please tell me and let me know his name; otherwise, please state distinctly whether you wish this office to make all arrangements for you.

I wish to repeat that I should like to receive your answer as soon as possible.

SCIENTIFIC NOTES AND NEWS

The following officers of the Medical Corps, U. S. A., have been promoted from major to lieutenant-colonel: Edward J. G. Beardsley, Philadelphia; Thomas P. Lloyd, Shreveport, La.; James A. Mattison, Hot Springs, S. D.; Joseph Sailer, Philadelphia; Oliver H. Campbell, St. Louis; Bertram F. Alden, San Francisco; Walter W. Crawford, Hattiesburg, Miss.; Jonathan E. Burns, Baltimore; Charles N. B. Camac, New York; William C. LeCompte, Bristol, Pa.; Harry T. Summersgill, San Francisco; Charles H. Schlichter, Elizabeth, N. J.; Edward W. Pinkham, New York; William J. Bell, Washington, D. C.; Warren A. Dennis, St. Paul; Joshua C. Hubbard, John H. Blackburn, Bowling Green, Ky.; Edmund J. Doering, Chicago; John E. Jennings, Brooklyn; William W. Percy, Rochester, N. Y.; John H. Blackburn. Bowling Green, Ky.; Edmund Moss, New Orleans; Henry R. Brown, Albuquerque, N. M.; Robert Smart, Coronado, Calif.; Herbert H. Smith. Highland, Kan.

Colonel Edward L. Munson, for twenty-five years an officer of the Medical Corps, U. S. A., has been promoted to the rank of brigadier-general, and with the promotion selected for duty on the general staff. The new commission is in the line of the army. General Munson is the third medical officer of the army to be given general officer's rank for duty outside the Medical Department of the army, the previous appointees being Generals Ainsworth and Leonard Wood.

Recall to the active list of Major-General William C. Gorgas, former Surgeon-General of the army, who recently was retired for age, and his assignment to active duty in the same rank of the Medical Corps has been announced by Secretary Baker. General Gorgas will complete the inspection of medical conditions in France and England, on which he now is engaged, and then will return to the United States to submit a report. His next assignment may take him to Italy.

Lieutenant-Colonel Frank P. Underhill, professor of experimental medicine at Yale University, in charge of the New Haven Station, Chemical Warfare Service, has arrived safely overseas. Lieutenant-Colonel Underhill is accompanied by the following officers of the station: First Lieutenants Henry D. Hooker, Jr., and Carl H. Greene; Second Lieutenants Alfred Chanutin and Arthur H. Smith.

Dr. Pierre A. Fish, professor of physiology, and head of the physiology department of the college of veterinary medicine of Cornell University, has been commissioned a major in the Veterinary Corps, U. S. Army. He has been granted a leave of absence from the university for the duration of the war.

Alfred J. Larson, Ph.D. (Harvard), assistant professor of chemistry, Carleton College, has been in the chemical service of the government for a year and was recently commissioned as captain.

James Ewing, D.Sc. (Aberdeen), assistant professor of biology, Carleton College, has been since a year ago in the Canadian Army and is at present an instructor in the Canadian university back of the lines with the rank of sergeant.

Dr. Roswell P. Angier, professor of psychology at Yale University, is a captain in the Sanitary Corps, National Army, at the Hazelhurst Field Medical Research Laboratory, Mineola, L. I.

Assistant Professor Jacobs, of the zoological department of the University of Pennsylvania, has received a captain's commission in the Food Administration.

Professor Lightner Witmer, head of the department of psychology at the University of Pennsylvania, has returned from his work with the Red Cross in Italy and will be on active duty this year.

Information has been received through private sources to the effect that Professor Charles Barrois, well known to many geologists in the United States, is still in Lille and in good health. His movements have been restricted and no communication was held with

him by his friends in France; but he has been occupied in lecturing at the university to some young Frenchmen who were wounded at the time of the evacuation of the city four years ago and to others who have recovered from typhoid fever. As he could not undertake out-of-door studies, his attention has been turned to the paleontological material on hand in the museum collections. Professor Barrois now has the satisfaction of welcoming his compatriots after their recovery of Lille.

Professor L. R. Cary and Dr. Alfred C. Mayor have returned from an expedition of the department of marine biology of the Carnegie Institution of Washington to Samoa and Fiji. The expedition discovered that the growth-rate of Pacific corals is fully twice as fast as that of corresponding genera in the Atlantic. Also the occasional currents set toward the coast against the prevailing westerly drift of the surface waters of the Pacific are relatively acid in comparison with the water of the westerly drift.

Professor F. S. Earle has gone to Porto Rico, where he is to investigate for the United States government a serious and rather obscure disease of sugarcane.

In giving the teaching staff of the department of chemistry of the College of the City of New York in the issue of Science for October 4 the word "emeritus" was misplaced by a printer's error so that it occurred after the name of Professor Charles Baskerville, head of the department, instead of after the name of Professor L. H. Friedburg, who has retired after teaching in the college for some thirty years.

Professor Ellwood B. Spear, of the department of chemistry of the Massachusetts Institute of Technology, gave an illustrated lecture on "Some of the Problems of Gas Warfare" at the Brooklyn Institute of Arts and Sciences on October 19. Much of the material presented was first-hand experience since, as consulting expert to the Bureau of Mines, Professor Spear has dealt with problems of defense and offense, including gas masks and mustard gas.

Dr. Herbert G. Keppel, head of the department of mathematics at the University of Florida, died on October 5 at the age of fifty-two years. Dr. Keppel had been serving as a member of a National Commission to supervise the mathematics instruction given by the Y. M. C. A. at military camps, and while away from home on this duty contracted Spanish influenza, which resulted in his death.

Livio Morelli, professor of medicine at the Pisa University, died on October 16, as the result of an infection contracted during a bacteriological research he recently conducted for the purpose of isolating the germ causing Spanish influenza.

The Journal of the American Medical Association states that at the request of the Surgeon-General of the U. S. Public Health Service, the officers of the American Public Health Association announce the postponement of their annual meeting, which was to have been held in Chicago October 14–17, to December 9–12, at the same place. This action was deemed advisable especially because it was considered unwise to ask sanitarians to leave their posts under present health conditions. Owing to the influenza epidemic prevalent throughout the country and the resultant increased demand for the services of doctors in their home communities, it has been considered advisable by the executive committee of the General Medical Board to cancel the meeting scheduled to be held in New York City at the Waldorf Astoria, on October 20. The regular annual session of the Clinical Congress of the American College of Surgeons, arranged for the week beginning October 21, has been cancelled for the same reason.

We learn from the London *Times* that a royal commission has been appointed "to consider and report whether it is advisable to make any changes in the denominations of the currency and money account of the United Kingdom with a view to placing them on a decimal basis, and whether, if an alteration of the present system is recommended, it is desirable to adopt with or without modification the proposals embodied in the Bill recently introduced into the House of Lords by Lord Southwark or

some other scheme, and in the latter alternative to make specific recommendations for consideration by Parliament." The members of the Commission are: Lord Emmott, Lord Southwark, Lord Faber, Lord Ashton of Hyde, Lord Leverhulme, Sir Richard Vassar Vassar-Smith, Bt., Sir Joseph Larmor, Kt., Sir George Croydon Marks, Kt., Sir Alfred William Watson, Kt., Mr. John Westerman Cawston, C.B., Deputy Master and Controller of the Royal Mint; Mr. Sydney Armitage Smith, Mr. Charles Godfrey, headmaster, Royal Naval College, Osborne; Mr. James Bell, Mr. Joseph Burn, Mr. Harold Cox, Mr. George Hayhurst, Mr. Theodore McKenna, Mr. Geoffrey Marks, Mr. James Francis Mason, Mr. Abert Smith, Mr. George Murray Smith and Mr. Gilbert Christopher Vyle. Lord Southwark moved the second reading of his Coinage (Decimal System) Bill in the House of Lords on June 4. He said it had the support of Chambers of Commerce, the Institute of Bankers, the Decimal Association, and many scientific societies. Lord Hylton, for the government, offered a joint committee of both Houses, and the debate was adjourned. Early in July Lord Hylton, in reply to a question by Lord Southwark, announced the forthcoming appointment of this Royal Commission. The Treasury announces that, pending the appointment of a secretary to the Commission, communications may be addressed to "The Royal Commission on Decimal Coinage, Treasury Chambers, London, S.W. 1."

A special diploma course for the training of merchants in the woolen and worsted industry has been introduced at Leeds University, according to a report received from Consul Percival Gassett. The course includes work in textiles, economics and languages. It is proposed to use the fine equipment of the clothworkers' department of the university in giving the student knowledge of the materials, whether wools, tops, yarns, or fabrics, with which he is to deal, in order that he may learn intelligently the best means of producing goods to meet the requirements of each particular market. As for economics, it is intended to include not only economic geography, but also industrial history and accountancy with, if possible, lectures by leaders of the industry dealing with the special features of the larger commercial life. The language training will be so designed that while the literature of the various countries will not be overlooked, opportunity will be given for acquiring technical knowledge of the languages essential to particular industries. The following is the plan as approved by the university council: *First year:* Textiles, economic geography, a modern foreign language, and accountancy (prescribed subjects); and one of the following subjects: A second modern language, mathematics, European history, and industrial history. *Second year:* Textiles, economics, two modern foreign languages, and accountancy. *Third year:* To be spent at some colonial or foreign university or institution of university rank.

The objects sought by Brazil in establishing state zootechnic stations in Amazonas, Para, Maranhao, Ceara, Piauhy, Rio Grande do Norte, Alagoas, Sergipi, Espirite Santo, Parana, Goyaz and Matto Grosso are thus given in the order of the Minister of Agriculture quoted in the New York *Evening Post* authorizing such stations: (1) Acclimation and immunization of imported animals. (2) The breeding of pure-bred bovines, swine, goats and sheep. (3) The breeding of crossbred horses of native stock with Arabic, English or English-Arabic types when possible. (4) The selection of domestic types of animals, in respective states. (5) The raising of breeding animals, to be loaned upon a reasonable fee to farmers and breeders in the state. The zootechnic stations are obliged to possess: (*a*) An area of not less than 200 hectares (489 acres), of which 150 (371 acres) must be artificial pastures and 50 (123 acres) cultivated with forage; (*b*) proper installation, such as stables, cattle dips and similar apparatus; (*c*) a stock of not less than 3 horses, 8 bovines and 12 sheep and goats of such breeds as the Bureau of Animal Industry may direct. The zootechnic stations will be supervised by the director of the Bureau of Animal Industry. To obtain

government assistance, documents must be presented showing the existence of suitable lands and other facilities to maintain such establishments.

UNIVERSITY AND EDUCATIONAL NEWS

It is planned to build a hospital on the campus of the University of Washington, Seattle, to cost a million dollars and which is to form the nucleus for a medical department of the university.

William P. Brooks, Ph.D., director of the Massachusetts Agricultural Experiment Station, has resigned his position. Dr. Brooks has been connected with the Massachusetts Agricultural College since 1889, previous to which he was professor of agriculture for twelve years in the Imperial College of Japan. He will continue in the service of the experiment station as consulting agriculturist.

Professor W. C. Sabine, acting director of the Jefferson Physical Laboratory of Harvard University, has retired and is succeeded by Professor Edwin H. Hall.

Dr. Paul F. Gaehr, of the department of physics at Wells College, has been appointed acting professor at Cornell University, where he will assist in the Students' Army Training Corps two days a week.

E. C. Auchter, associate professor of horticulture at the University of West Virginia, has been employed by the Maryland State College to head the department of horticulture.

Robert O. Caldwell, Ph.D. (Princeton, '18) formerly professor of physics at Geneva College, has accepted a position as assistant professor of physics at West Virginia University.

The following appointments have been made at Marquette School of Medicine: Mrs. Paul M. Smith, M.A. (Wisconsin), formerly assistant in botany at University of Wisconsin, as instructor in bacteriology. Mr. C. A. Hills, M.A., formerly instructor in physiology at the University of Kansas, now in charge of laboratory work in physiology and pharmacology, as instructor. Mr. A. H. Hersch, M.A., formerly instructor in biology at the Kansas State Agricultural College, as instructor in the department of anatomy and biology.

DISCUSSION AND CORRESPONDENCE

MR. ABBOT'S THEORY OF THE PYRHELIOMETER

To the Editor of Science: Referring to Mr. Abbot's open letter to me, published in Science, June 21, 1918, I should like to make a few remarks. The important points can be taken as two, which require attention.

1. The first is that my research ranks as an "interesting speculation" without "quantitative value." After adapting the Boyle-Gay-Lussac Law, $P = \rho RT$, to atmospheric physics, the computations proceed by using only the standard formulas of thermodynamics, kinetic theory of gases, and electron physics; the checks are always complete and numerous; the results are in full agreement with observational data, so that Mr. Abbot's statement implies that these laws have no application in free atmospheres, which few will admit. The results have succeeded in clearing up a long series of heretofore unsolved problems, circulation, thermal data of various types from the adiabatic strata to the top of the various atmospheres, the origin of atmospheric electricity and magnetism, the thermodynamic environment of several spectra in the sun, and the end is not in sight. The Planck theory of radiation, the Bohr origin of spectrum lines, and the electron-atomic data are already seen from a new point of view. There are few computations whose data interpenetrate and are supported by so many distinct series of physical laws as are these, and the evidence is that they form the basis for future developments in atmospheric physics.

2. The second point is that Mr. Abbot reiterates this argument: that his well-known method of discussing the pyrheliometric observations must be correct, because it produces the same solar constant, 1.94 9^s. cal./cm,^{2} min., when repeated many times at many stations. If the method is erroneous it can not be made valid by repetition. It will be recalled that

Professor Langley deduced from his bolometer studies about 3.00 calories; that Angström and others obtained 4.00 calories, and those were common results for some years. Mr. Abbot reduced the value to 1.94 calories, relying solely upon the pyrheliometer, and at the same time recognized that the ordinates of the bolometric spectrum indicate a solar temperature of about 7000° A., the pyrheliometer requiring only 5800° A. He passed over this wide discrepancy by assuming that the sun does not radiate as a black body. This is the critical point. The Poynting equation of equilibrium asserts that the surface flux of radiation over a given volume sustains a certain volume density whose temperature is T. This equation has been applied by me in detail to the earth's atmosphere, so that in ten distinct integrations the volume density from the sea level to the vanishing plane amounts to 3.98 calories; it has been applied in the sun's atmosphere with the result that the solar radiation originates in a deep isothermal layer at the temperature 7655°. It is, therefore, black radiation, of an equivalent value of 5.85 calories; using Abbot's coefficients of transmission for several spectrum lines, from the center to the limb, this is depleted by 1.87 calories, thus agreeing with the terrestrial data and the bolometer. This result destroys Abbot's theory, and renders his pryheliometric method useless.

It is not difficult to understand the source of Mr. Abbot's error. He relies upon the Bouquer Formula of depletion, and, indeed, substitutes this for the Poynting Theorem, which is erroneous. When there is lack of equilibrium between the surface flux and the volume density, there is a product of free heat, $dQ = cdT$, while the temperature is changing. The pyrheliometer works on this change of temperature alone, omits to register the stored potentials and inner energy within the metals, glass, mercury, these last being very difficult to follow. In short, Abbot's theory identifies the surface flux of radiation with this free heat, and it follows that it does not manifest the entire radiation received. For these reasons I have abandoned Abbot's methods and substituted those found in my "Treatise on the Sun's Radiation." It may be noted that the pyrheliometer is a very inefficient apparatus for atmospheric studies, because it is unable to eliminate the depletions due to the effects of vapor, dust and even molecular scattering in the higher levels. Applying certain correcting ordinates, the stations at Cordoba-Pilar, 438 meters, and at La Quiaca, 3465 meters, are working together within 0.02 calories, and they follow the solar variations as indicated by the sun-spots, prominences, magnetic field and the meteorological data in Argentina. It is imperative that Mr. Abbot should abandon his unfortunate pyrheliometer method, which is flatly contradicted by a very extensive series of data, in favor of the results which are clearly indicated by his admirable observations with the bolometer.

FRANK H. BIGELOW

SOLAR AND MAGNETIC OBSERVATORY,
PILAR, F. C. C. A., ARGENTINA,
August 7, 1918

FIREFLIES FLASHING IN UNISON

TO THE EDITOR OF SCIENCE: In SCIENCE for July 26, 1918, there appears an article on "Fireflies Flashing in Unison," by Edward S. Morse. Confirming his statement and that of other observers that fireflies do at times synchronize their flashes I beg to relate an instance that occurred on the evening of May 4, 1918, on the Benguet road. At that time I was a passenger on the auto-stage run by the Philippine government between the railroad station at Mangaldan and Baguio. As the stage rounded one of the numerous curves on the grade there appeared on our left, apparently in motion, a ghostly incandescence which came and went in regularly repeated flashes and intervals of darkness. The appearance was uncanny and was plainly visible to all the passengers in the stage. We did not at first realize its cause but soon attributed it to fireflies. As I have said the light was apparently in motion, but I am inclined to believe that the insects which caused it were not in continuous flight but were congregated (as is frequently the case in the Philippines) about some tree standing

below us on the mountain slope and that the apparent motion was caused by the actual motion of the stage. At any rate there can be no doubt that the fireflies were flashing in unison.

Fremont Morse
Director of Coast Surveys
Manila, P .I.

SCIENTIFIC BOOKS

The Passing of the Great Race. By Madison Grant. New York, Charles Scribner's Sons. 1918. Pp. 296.

It is rare that an author of a scientific work which is not a text-book has the pleasure of seeing a second edition within two years. Mr. Madison Grant's recent success is sufficiently justified, since he has written both boldly and attractively, and has produced a work of solid merit. Even the title, "The Passing of the Great Race," is of the sort to make a popular appeal, for there always seems to be an eagerness to read of some horrible future in store for mankind. Hence the success of books on degeneracy, race suicide, cessation of intellectual evolution, disgenic influence of war, and the elaborations of obvious pessimism—books and articles usually written by persons blind to the complexity of the problems and to the optimistic significance of facts and arguments on the other side.

Mr. Grant believes in the inborn value of the Nordic race, that tall, fair-haired, long-headed breed which started from the shores of the Baltic some three thousand years ago, formed the ruling classes in Greece, Rome, northern Italy, Spain, northern France, England and parts of the British Isles, and then, in the southern countries, passed away either through its inability to stand the climate in competition with brunette types, or through dilution and pollution of its blood by mixture with inferior peoples.

The present reviewer accepts, in the main, this racial theory of European historical anthropology. This theory rests upon two chief factors. The first is that so well elaborated by Mr. Grant in his book, namely, that it is supported by the facts of history. In other words, if we start with an extreme "hereditarian" hypothesis as to the special value of the Nordic race, we do write a good ethnological and anthropological history of European and Asiatic culture. The broad panoramic changes are systematically and reasonably explained by such an hypothesis. There is no shifting about—something relying on a theory and then having constantly to resort to some involved explanation because the theory has failed to work. In all this Mr. Grant's book is admirable; but it is open to criticism at the hands of opponents. The author rarely if ever discusses disputed points. For instance, he alludes frequently to the fact that in all European literature and art, the heroes, saints and madonnas have always been depicted as blondes, but he ignores the fact that its significance has often been questioned. In this matter, antagonists to the doctrines of heredity and to the native superiority of the blonde race usually say that the blonde type was admired because of its rarity. How is this to be answered? It is an affair of the author, not the reviewer.

In the last pages of his book, Mr. Grant gives a bibliography; but nowhere does he insert a footnote or give a reference to the sources of his information. While this may in some slight degree make the text more readable, it is a great pity that a reader can not more easily trace to their origins or further investigate many of the interesting and novel statements met with in this provocative book.

The second good reason for believing in the importance of inborn native mental differences, and consequently in the truth of most of what Mr. Grant asserts, is that there is a mass of carefully finished statistical research on the problem of human heredity which tends to support the whole theory of race as against environment. If adult human differences within a single family and within a single class are largely the result of pre-formed differences in the chromosomes of the primary germ cells, then there is at least a good hypothesis that the same is true for racial differences.

However, it requires further proof in the case of race, since the children of the same

families have a comparatively uniform environment, but different races necessarily carry with them each to some extent its own peculiar *milieu* We can not in our present knowledge assert how far this goes. Certainly races and indeed nations can be at least temporarily modified by an education and training imposed in the interests of, and by the will of, a very few persons, as for instance, Germany during the last half century.

This factor of leadership in the rise and decline of races is generally overlooked by Mr. Grant, as is the problem of the formation of upper classes. Mr. Grant fears that the Nordic race is passing away. There is much to be said in substantiation for this unpleasing prospect, and if there is much to be said, certainly Mr. Grant has said it. The present reviewer does not take such a gloomy view. There are internal forces silently and continuously working towards the improvement, not of the whole race, but of a part of it, and this part tends further to improve with its own improvement. Some of the tendencies or correlations working towards melioration are assortative mating (*i. e.*, tendency of like to mate with like), general truth as far as results at present indicate of desirable traits within an individual to be correlated with other desirable traits, general tendency of long-lived people with a tough resistance to leave more offspring than the average, besides other recently discovered correlations bringing an encouraging outlook.

There are some of the phases of human evolution that ought to be more generally recognized and incorporated into all discussions on the rise and decline of races and of nations.

In spite of such criticism, "The Passing of the Great Race" is an interesting and valuable pioneer attempt at an interpretation of history in terms of race. The origins and migrations of the three primary European races, Nordic, Alpine and Mediterranean, are here instructively and graphically portrayed. The colored charts make it easy to grasp the outlines of the author's theory. This is a book that will do much to widen the rapidly expanding interest in eugenics and help to disseminate the ever-growing conviction among scientific men of the supreme importance of heredity.

FREDERICK ADAMS WOODS

War Bread. By ALONZO E. TAYLOR. New York, The Macmillan Co. 1918.

Almost since the outbreak of the war Dr. Taylor has been engaged in the study of the food problem, at first in Germany in the interest of British prisoners in German camps, then in Holland, making a survey of Dutch food resources, and he has later served as chief scientific adviser of the Food Administration of Washington and has made frequent trips to Europe. This little book, presenting as it does the cereal situation of the Allied countries in the spring of 1918, bids fair to become a classic. Reading it, one can realize how a fortunate wheat crop this year will allow us to send wheat to Europe directly without involving the increased number of ships necessary to transport it from far-away Australia or the Argentine. The book clearly shows how failure to conserve wheat plays into the hands of the enemy and tells of the methods employed for its conservation.

GRAHAM LUSK

A STUDY OF ENGINEERING EDUCATION

THE Carnegie Foundation for the Advancement of Teaching has just issued its Eleventh Bulletin, A study of Engineering Education, which has been in process of development during the past four years in cooperation with the joint committee on engineering education of the national engineering societies.

Engineering education was established on a large scale only fifty years ago on the basis of the experience of foreign countries, particularly France. Since then, applied science has made marvelous progress, and in order to meet that progress, the original curricula of the schools have been modified here and there and from time to time in a haphazard way. The result is that modern engineering curricula lack coherence and unity and have for a number of years been the object of criticism by the engineering profession.

Some ten years ago, the Society for the Promotion of Engineering Education appointed a committee to make a comprehensive study of the situation, and this committee associated with it delegates from the five great national engineering societies. This joint committee has been cooperating with the Carnegie Foundation in this study, and the bulletin just issued is the result of their united labors for the past four years. The bulletin was prepared by Dr. Charles R. Mann, formerly associate professor of physics in the University of Chicago, now chairman of the advisory board to the War Department committee on education.

The origin of the present system of engineering schools is traced in detail and its characteristics, both good and bad, are frankly stated. Its operation is studied mainly from the point of view of the effect upon the student and there is a careful examination of entrance records and college courses, as well as a brief summary of the current methods of instruction. On the basis of this analysis of the present situation, the larger problems of engineering education are considered to be those of admission, content and courses, faculty organization, and curriculum. The treatment culminates in a definition of each of the larger problems in terms of the requirements of the profession and of the young men who wish to enter. The chapters on admission and on testing and grading describe a series of new and original experiments carried out by Professor E. L. Thorndike, of Columbia University, in an effort to secure a more rational method of measuring engineering ability.

The constructive portion of the bulletin presents numerous suggestions as to ways and means of solving the problems thus defined, in an effort to reach the general principles which seem best qualified to help each school in solving the problem according to its own peculiar circumstances. Among the suggestions may be mentioned the necessity for more objective methods of rating and testing students and more accurate records of achievement; the need for closer cooperation among the several departments of instruction at each school; the introduction of practical experience with engineering materials into the freshman year; and the increase in the emphasis placed upon the humanities and humanistic studies.

The final chapter, entitled "the professional engineer," presents the results of an extended study of the demands of the engineering profession, and indicates that these demands can be fully met by the application of the principles that are developed in the preceding chapters. The thesis is set up that the chief lack in engineering education is the failure to recognize the importance of values and costs in all engineering work and suggests ways and means in which this idea may be emphasized to advantage both in the technical and the humanistic work. Engineering education is here shown to be but one branch of all education, and it is suggested that the methods of improving both are identical. Therefore, the bulletin has a wider interest than its title would imply and may be read with profit by educators of all kinds.

Copies of the Bulletin may be had by addressing the Carnegie Foundation, 576 Fifth Avenue, New York City.

TWO NEW ANTHROPOLOGICAL JOURNALS

DURING the present year two new anthropological journals have made their appearance—one devoted to physical anthropology, the other one devoted to American linguistics.

The establishment of the *American Journal of Physical Anthropology* is due to the energy of Dr. Aleš Hrdlička, curator of the division of physical anthropology in the United States National Museum. Up to the present time two numbers have appeared, which indicate that the scientific standard of the *Journal* will be a high one. The first number is introduced by a preface, and a general survey of the scope and aims of physical anthropology, both written by the editor Dr. Hrdlička. In the second number the editor gives a brief review of the history of physical anthropology in America. The department of literature is very full and exhaustive and gives a review of

all important publications that have appeared recently.

The second journal, *The International Journal of American Linguistics*, is edited by F. Boas and Pliny E. Goddard, with the assistance of Professor Uhlenbeck, of Leiden, and Dr. W. Thalbitzer, of Copenhagen. The first number of the journal contains a brief introduction setting forth the object of the journal. Special articles which have so far appeared deal with the languages of Central America and North America. In the reviews a summary of work done by the Bureau of American Ethnology is given.

F. B.

SPECIAL ARTICLES

THE RELATION OF THE PLANT TO THE REACTION OF THE NUTRIENT SOLUTION

ONE of the important factors to be considered in plant nutrition studies is the reaction of the nutrient solution. The determination of H ion concentration is of value, not only because of its general relation to plant growth, but also because of its bearing on the nature of selective absorption of ions. At the present time various misleading statements exist in the literature with regard to these points. In many cases principles which are elementary to the physical chemist have not been sufficiently appreciated by the agricultural chemist. In the course of extended studies conducted by this laboratory to determine some effects of concentration of the nutrient solution on plant growth and absorption, opportunity has been afforded for ascertaining the exact reaction of the nutrient media under widely varying and carefully controlled conditions. The purpose of the present article is the discussion in a preliminary way of this phase of the investigation.

It is a quite common impression that the plant by selective absorption may so alter the reaction of the nutrient solution as to produce extreme alkalinity or acidity. For example, Palladin[1] in describing water culture experiments states:

> Während der Vegetation muss dafür gesorgt werden, dass die Kultur flüssigkeit nicht alkalisch wird. Zur Beseitigung der alkalischen Reaktion wird so lange schwache Phosphorsäurelösung zugesetzt, bis die Lösung schwach sauer reagirt.

Also it is often claimed that from KCl, K_2SO_4, and similar solutions the cation is removed at a rate so much faster than that of the anion that a marked acid reaction ensues, which may result in injury to the plant. Conversely a $NaNO_3$ solution is said to become alkaline. The evidence on which these ideas are based is very slight. Some of the experiments quoted were performed many years ago, when chemical methods and principles were in a relatively imperfect stage of development. The condition of acidity of alkalinity in most of the investigations has been measured by various titrations, which for this purpose are subject to misinterpretation, as pointed out in a previous article.[2]

In the latter investigation experiments with barley seedlings indicated a strong tendency on the part of the plant to change the reaction of various potassium phosphate solutions in the direction of neutrality; either acid or alkaline solutions soon attained a H ion concentration equivalent to approximately P_H 7.0, while neutral solutions remained unaltered in reaction. These experiments have now been extended to other solutions including complete nutrient solutions, and observations have been made at all stages in the growth cycle of the barley plant. Also several varieties of beans have been used. The experiments were carried out by means of sand and water cultures, which will be described elsewhere. It will suffice to state here that the technique was such as to permit of the production of normal, well matured plants. In every instance, without exception, nutrient solutions with an acid reaction reached an approximately neutral reaction after contact with the plant roots for varying periods of time. Even where plants were grown to maturity without change of solution, the neutral

[1] Palladin, W., "Pflanzen physiologie," Berlin, 1911, p. 82.

[2] Hoagland, D. R., "Soil Science," Vol. III., No. 6, pp. 547-560, 1917.

reaction remained constant throughout the entire period. The data from a number of typical experiments are presented below. H ion concentrations were usually determined colorimetrically, with the methods and indicators described by Clark and Lubs.[3]

TABLE I

Description of Plant	Solution	Time of Contact	Reaction at Beginning, P_H	Reaction After Contact with Plant, P_H
Barley grown to maturity. No change of solution	Complete nutrient 1500 p.p.m.	4 mos.	6.8	6.9
Barley 6 weeks	Complete nutrient 2500 p.p.m.	1 week	5.6	6.8
Barley 7 weeks	Complete nutrient 1500 p.p.m.	22 hrs.	5.1	6.1
Barley 7 weeks	Complete nutrient 1500 p.p.m.	36 hrs.	5.1	6.8
Barley 7 weeks	Complete nutrient 5000 p.p.m.	50 hrs.	5.0	6.1
Barley 7 weeks	Complete nutrient 5000 p.p.m.	96 hrs.	5.0	6.5
Barley grown to maturity	Complete nutrient 300, 1000, 2500 p.p.m.	12 weeks	6.8	6.5–7.2

Chemical analyses of the solutions made it clear that the change in reaction had been the result of selective absorption from the various phosphoric acid anions, accompanied by an equivalent removal of positive ions. A marked regulatory absorption is apparent.

Other experiments were made in which barley plants were grown for seven weeks in favorable nutrient solutions and then transferred (after thoroughly washing the roots in distilled water) to solutions of KCl, K_2SO_4, $MgSO_4$, K_3PO_4, NH_4Cl and $NaNO_3$. The reactions of the solutions were tested after varying periods of contact from a few hours to forty days. In no case was a condition either of excessive OH ion or H ion concentration produced, although absorption had been active. The acid reaction when present was due to slightly dissociated acids, usually carbonic, or to acid salts in the case of the NH_4Cl solution. Possibly in some cases organic acids were formed.

[3] Clark, W. M., and Lubs, H. A., *Jour. Biolog. Chem.*, Vol. XXV., No. 3, pp. 479–510, 1916.

TABLE II

Salt Used. (Concentration 1,500 p.p.m.)	Time of Contact	Per Cent. of Salt Absorbed (by Conductivity)	Reaction After Contact, P_H	Reaction Solution After Heating, P_H
KCl	39 days	42.6	5.3	6.5
$NaNO_3$	39 "	56.5	7.2	9.5
$MgSO_4$	16 "	22.9	6.5	7.0
K_2SO_4	16 "	36.8	6.3	7.0
K_3PO_4(1)	16 "	33.0	7.5	—
NH_4Cl(2)	8 "	30.0	5.0	—

P_H original solutions (1) 10.3, (2) 5.7.

Barley plants grown seven weeks in complete nutrient solutions.

Very striking is the change induced in the K_3PO_4 solution. From a condition of intense alkalinity the solution became approximately neutral. The NH_4Cl solution retained an acid reaction. This would necessarily be the case as long as any NH_4Cl remained unabsorbed. The H ion concentration was slightly increased after contact with the plant, but less than would occur if even 1 p.p.m. of residual HCl were formed. Analysis of the solution showed a considerable absorption of both ions, but about 5 per cent. more NH_4 than Cl was removed. The balance was restored, however, by the excretion from the plant of equivalent quantities of other bases, chiefly calcium. There is no evidence that NH_4OH was absorbed with the formation of a residue of HCl. At least neither the analysis nor the reaction indicates that the absorption took this course.

After boiling the $NaNO_3$ solution gave an OH ion concentration similar to that produced by the hydrolysis of Na_2CO_3. The residual solutions of $NaNO_3$ and KCl were analyzed with the following results.

From the above it may be inferred that part of the NO_3 was removed simultaneously with an equivalent quantity of Na, but more NO_3 than Na was absorbed, HCO_3 ion entering or being formed in the solution to restore the

TABLE III

Analyses of Solutions

	$NaNO_3$ Solution				KCl Solution			
	At Beginning	After Contact with Plant	Absorption by Plant	Per Cent. Absorption	At Beginning	After Contact with Plant	Absorption by Plant	Per Cent. Absorption
	p.p.m.	p.p.m.	p.p.m.		p.p.m.	p.p.m.	p.p.m.	
Ca...	....	11	....		....	14	...	
Mg..	....	...	....		....	2	...	
K...	....	...	....		1380	812	568	41.1
Na..	690	329	361	52.3	....	...	...	
HCO_3	....	517	....		....	15	...	
Cl...	....	...	....		1248	732	516	41.3
NO_3..	1860	335	1525	81.9	....	...	...	

Barley-plants grown seven weeks in complete nutrient solutions.

Contact with $NaNO_3$ and KCl solutions 39 days.

balance. This ion in equilibrium with dissolved CO_2 brought about a neutral reaction in the solution actually in contact with the plant. From the KCl solution K and Cl were absorbed in equivalent quantities. On the basis of these results it is clear that the selective action for NO_3, while it does not of itself cause any injurious reaction, might eventually give rise to an alkaline condition in the soil as a result of the accumulation of Na_2CO_3. This is in accord with the usual conception. However, it is not easy to reach the conclusion that KCl, K_2SO_4, etc., could bring about an acid reaction in a similar manner. That such a result actually occurs in the soil as the result of salt treatments has been shown by Sharp and the author[4] and by Plummer,[5] but the increase in the intensity of acidity may be ascribed to interreactions in the chemical system of the soil, irrespective of plant absorption.

The extensive analyses of Pantanelli[6] would indicate that in the case of almost every salt, after a few hours contact, the plant has absorbed more of one ion than the other. Nevertheless in the periods of time in question only minute quantities were removed and the exchange of ions between the plant and solution was not excluded from consideration. The researches of Nathanson[7] show the possibility of such an exchange. For example, the absorption of NO_3 by certain algæ may be accompanied by a loss of Cl from the plant. Nathanson emphasizes the necessity of a state of equilibrium in the solution and it is self-evident that the equivalence of positive and negative ions must be maintained. Thus, if K is to be selectively absorbed from a KCl solution it must be as KOH, with a residue of HCl. The determinations of reaction and analyses of residual solutions are not in favor of this mechanism. It would seem the final result must be either the equivalent absorption of both ions or the exchange of ions between plant and solution. In a complex nutrient solution or in the soil unlimited possibilities of combination exist.

It is true of course that much evidence has been adduced by Pantanelli, Nathanson and others in support of the hypothesis of the absorption of ions as such, but no evidence obtained from a study of the nutrient solution seems capable of conclusively demonstrating the precise mechanism of the intermediate steps in the absorption. In this general connection the universally known work of Loeb and Osterhout bearing on the ionic nature of antagonism will be recalled. In any case, whether molecular or ionic absorption or ionic exchange is concerned the resultant solutions do not attain a concentration of H ion or OH ion indicative of the presence of highly dissociated acids or bases, while in complex nutrient solutions an approximately neutral reaction is produced as a result of absorption by the plant.

II

The nature of acid soils and their relation to crop growth have been among the topics most widely discussed by soil chemists. The common occurrence of soils distinctly acid (in the physical chemical sense) has been pointed

[4] Sharp, L. T., and Hoagland, D. R., *Jour. Agr. Res.*, Vol. VII., No. 3, pp. 123–145, 1916.

[5] Plummer, J. K., *Jour. Agr. Res.*, Vol. XII., No. 1, pp. 19–31, 1918.

[6] Pantanelli, E., *Jahrb. f. wissen. Botanik*, Vol. 56, pp. 689–733, 1915.

[7] Nathanson, A., *Jahrb. f. wissen. Botanik*, Vol. 38, pp. 241–290, 1902–03; Vol. 40, pp. 403–442, 1904; Vol. 39, pp. 607–644, 1903–04.

out by Gillespie[8] and by Sharp and the author.[4,9] Recently Plummer[5] has confirmed these views and presented much additional data. It is often assumed that most agricultural plants require a slightly alkaline reaction in the soil. Previous work has shown that a reaction of P_H 5.0 is in no way inhibitive to the growth of barley seedlings. This point has been investigated further, with the use of several varieties of beans in sand cultures. The solutions were changed with sufficient frequency to maintain constantly an acid reaction. No evidence of injury was apparent. Truog[10] upholds the view that the acidity per se is not ordinarily the limiting factor in acid soils.

With reference to the latter point it may be of interest to present some observations made on an area of California peat soils. All were found to be decidedly acid, as follows:

TABLE IV

P_H of Soil Suspensions

Description of Soil	P_H
1. Surface, never cropped	5.4
1a. Subsoil from above	6.0
2. Surface, cropped 15 years	4.9
2a. Subsoil from above	4.9
3. Surface, 2 years in potatoes	5.1
3a. Subsoil from above	4.6
4. Surface, barley field	4.5

In sections where other inhibiting factors were absent first class crops of barley, oats, beans, potatoes, onions, corn, asparagus, etc., were produced. Incidentally it may be mentioned that from 100 to 3,000 p.p.m. of NO_3 (basis of dry soil) were found. It is evident that in these soils the acid reaction did not interfere with the growth of crops nor the formation of nitrates.

D. R. Hoagland

Division of Agricultural Chemistry,
California Agric. Experiment Station

[8] Gillespie, L. J., *Jour. Wash. Acad. Sci.*, Vol. 6, No. 1, pp. 7–16.

[9] Hoagland, D. R., and L. T. Sharp, *Jour. Agr. Res.*, Vol. XII., No. 3, pp. 139–148, 1918.

[10] Truog, E., *Soil Science*, Vol. 5, No. 3, pp. 169–196, 1918.

AN ELECTRO-THERMO-REGULATOR FOR WATER BATHS

The majority of electro-thermostats so far devised and in use in paraffin ovens, incubators and control chambers have been constructed to operate directly in the chamber itself. Such installation is not wholly desirable, inasmuch as a regulator so placed is subjected to sudden and extreme variations of temperature each time the door or compartment is opened. This not only interferes with the stability and accurate operation of the instrument itself, but causes an unnecessary number of "makes" and "breaks" on the part of the mechanism, with its attendant corrosion of the contact points, and is also conducive to fluctuations in the temperature caused by the unnecessary heating and slow cooling of the heating element. The thermoregulator herewith described is designed to be inserted in the tubulature of the incubator, where it is immersed in the water of the water jacket. It is intended to be used in connection with a secondary switch in circuit with an electric heating element. So employed, and with a moderate current passing through the primary circuit, the thermostat will give continuous control within a fraction of a degree of the specified temperature.

The thin brass casing *C* is 29.5 cm. long by 2.5 cm. outside diameter. It is strengthened at its upper end by a collar *D*, which extends on one side to form a rigid arm *A*. Binding posts *B* and *B′* are for wires leading to the secondary switch, which is placed in some out-of-the-way situation. They are thoroughly insulated from the arm *A* by red fiber composition. Binding post *B′* is bolted securely to a curved saddle-piece *S*, in which is suspended a bent lever *L*. Platinum points *P* and *P′* of generous size are soldered to binding post *B* and lever *L* respectively, while a no. 3 cover glass *T* is cemented with hard shellac to the vertical arm of the lever, insulating it from the rest of the mechanism.

The thermostat operates on the principle of the unequal expansion of two different metals composing a couple. Zinc and iron make a sensitive combination; but lead and iron, alu-

minum and iron, copper and iron and other combinations may be used, except that there is a loss in sensitiveness in the order indicated. Two pieces or strips E and E', each about 9.0 mm. in width and 6.0 mm. thickness are riveted together and imbedded in solder V at the bottom of the casing. A screw N and lock-nut R provide means of adjustment of the parts. This method of construction makes a rigid column which is not subject to the vibrations common in a laboratory. In practise, the casing is filled with glycerin, which increases the continuity of parts and prevents corrosion of the metallic couple.

The advantages of this design other than those already mentioned are apparent. First, the generous length of the metallic couple insures a maximum of sensitiveness. Second, this sensitiveness is further increased by the mechanical advantage of the lever. Third, continued movement of the bimetallic column in either direction imposes no strain upon any of the parts of the mechanism, a feature not incorporated in thermostats to be found on the market, and one which makes possible accurate control with least adjustment for long and continuous periods of time.

In the construction and testing of this thermostat, the writer is indebted to the New Hampshire College and Experiment Station for the use of laboratories and equipment.

Chas. H. Otis

Biological Laboratory,
Western Reserve University,
Cleveland, Ohio

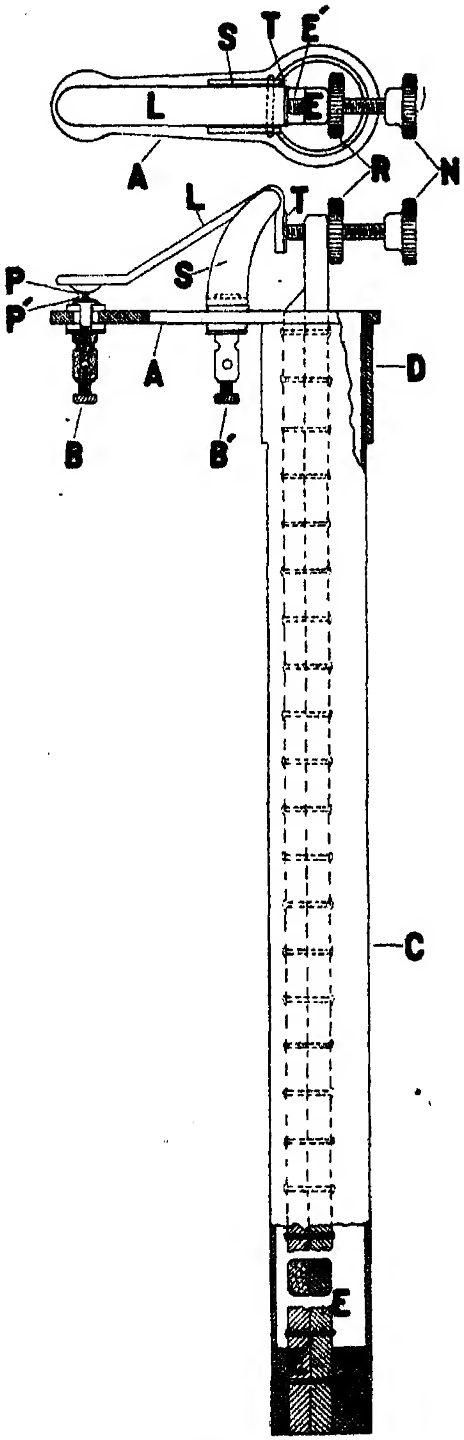


Fig. 1.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

Friday, November 1, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE BALANCE, THE STEELYARD AND THE CONCEPT OF FORCE

The primitive philosophy of *Animism,* "the doctrine that a great part, if not the whole, of the inanimate kingdom, as well as all animated beings, are endowed with reason, intelligence and volition, identical with that of man," still to a degree sticks in mechanics, in the concept of force. Schopenhauer is quoted as saying:

> That the essence of forces in inorganic nature is identical with the will in us, every one believes with full certainty and as a demonstrated truth, who seriously considers it.

R. Eisler says:

> Force is a concept which gets its content originally from the capacity of the ego in general by means of its will to bring about something, to overcome a resistance, and is then immediately superposed upon the objects of the external world. . . . Since the ego finds limits to its activity in the external world, feels itself hindered by objects, it inevitably interprets the hindrance as the expression and activity of a sort of will-power analogous to itself which things exert against it and by virtue of which they can or do influence other things. . . .

E. Mach says that the concept of force is a survival of fetishism; Kirchhoff, in the famous prefix to his Mechanics, acknowledges the value of the older view in the development of the science, and its usefulness in elementary teaching, but takes for himself this higher ground:

> I propose as the problem of mechanics, to describe the motions which occur in nature, and, forsooth, to describe them completely and in the simplest way. I will further add that it should deal only with this, to state what the phenomena are, not to determine their causes.

For him the term force "forms only a means of simplifying the forms of expression, *i. e.,* to express in brief phrases equations which with-

out the use of this name could only with difficulty be expressed in words."

Believing that the history of a growing concept is sometimes an aid towards a teacher's understanding of his students' difficulties. I have been interested in forming a conjectural reconstruction of the history of this force concept, from the hidden days of pure animatism to the time when a distinct separation between matter and force concepts began to show itself; helping myself meanwhile with such facts as archeology scantily shows us about the most ancient tools, contrivances and ways of life.

To put the problem as a question: When and how was it learned that very different objects may have the same weight? That the same object may have different weights? To treat of force mainly in the weight form is no wrong, on account of the universality of gravitation and the fact that forces even to-day are measured mainly in terms of weight.

The second question is quickly answered; before Richer in 1673 returned to Paris from Cayenne with a report on the going of his clock in the two places, no one had suspected a variability of weight; Huygens concluded from this report that bodies in high latitudes fall faster, and are heavier, than in low; but even now this conclusion remains a deduction from refined instrumental observation; no mason's assistant can say from his personal experience that it is harder to lift a hod of bricks in Edinburgh than in Quito. To us all, the weight of a thing is constant.

That different objects may have the same weight is an extremely ancient idea, so familiar as to be a truism, I dare say, even to the pyramid builders and their forefathers. But I suppose that even truisms were once discoveries; this one, perhaps, became the property of man because he labored.

Assuming that sensations of effort are real, I would classify them, perhaps naïvely, in three groups: Sensations of

(*a*) Effort proper—central, which go with the sending of the nerve message from the central nervous system.

(*b*) Stress—the nerve message reaches the muscles, they contract, their changes in form affect the sensory endings of themselves and of neighboring parts, as the skin, the joints, etc., by virtue of arterial and venous compression, the circulation and the breathing also are affected, and, through them, distant parts of the body.

(*c*) Yielding—*changes* in stress occur when external bodies give way to the muscles and bones, or when the body itself is moved, as in jumping.

Normally (*a*) and (*b*) go together; in nightmare most of us have felt the will paralyzed, the body apparently not responding to the centers; in paralysis the separation may be permanent; I have read that the separation occurs in curare poisoning, when the motor nerves no longer actuate the muscles, but consciousness and sensation remain.

But (*c*) varies with the object dealt with, and also, for the same object, with bodily health and tone. It varies with the way the object is dealt with. Its variations, combined with the evidence of other sensations, enable us to distinguish between the self and the not-self, and between the parts of the not-self, of the external world. With (*a*) and (*b*) but without (c) we would know little of the mechanical qualities of bodies. With (*c*) we get notions of bodies differing not only in color, odor, etc., but also in weight; for to move objects, whether to lift, carry or throw them, requires effort, and the efforts for lifting, carrying and throwing a given body are of the same order of magnitude. Like bodies of about equal extent require like efforts; like bodies of unequal extent require unlike efforts; but equal extent does not condition equal efforts; *e. g.*, a block of wood and a boulder. So we can add to the differing qualities of bodies given by sensations of color, odor, etc., weight and specific heaviness. This effort-demanding quality, varying among bodies and with the condition of the person, would early be abstracted, and the concept weight would appear, in positive (heavy) and comparative (heavier, lighter) degrees. Weight was found to be a quality of solids and liquids universally; the sensations of effort have not yet

made it apparent to us in the case of air, and Galileo first showed it there by experimental means—weighing compressed air—which appeal to other senses and to the reason. The savage laborer would have a rough idea of equality in his backloads, he might recognize this equality in backloads of venison or firewood, he might count backloads, bucks or arrows, and so attain crude notions of ratios, and in all things he would perceive the demand for effort, and so recognize the existence of *heavy matter* of all sorts; the sorts all being alike only in this effort-demanding quality.

Knowing effort only through the sensations of effort, which are subject to Weber's law, and through that form of hysteresis called memory, we can compare efforts, and the weights to which they correspond, only very crudely for equality, practically not at all for ratio, and with diminishing accuracy after longer intervening times. However, efforts being apparently equal, so are weights assumed to be, and, vice versa, bodies of like material and the same size are taken to have equal weights without "hefting them." One rabbit is about as big and so weighs about as much as another.

That two rabbits weigh twice as much as one, however, is not an experience, but a judgment. The effort sensation for two rabbits is not in any sense double that for one; if a man can lift a side of beef with great effort, is the effort required to lift two sides at once twice as great, when he perhaps can not lift the two sides at all? Is the effort made by a stronger man who lifts the two double that of the weaker lifting one?

A very ancient method of bearing loads, dating back to prehistoric times and portrayed in the most ancient records, is the carrying stick or yoke. Convenience and comfort in using this are greatest when the bearer is at the center, which is when equal numbers or volumes of like things swing from the two ends. This, I suppose, led to the invention of the balance with equal arms as a more refined and objective, more "honest," means for the inverse purpose of testing equality in respect to this effort-demanding quality, *weight or quantity of matter*. One Greek name for the balance is *ζυγόν*, yoke; but the implement itself dates to measureless antiquity. H. L. Roth,[1] quotes Mr. Ivan Chien, of the Chinese Legation in London, to the effect that Chinese history assigns the making of scales to the reign of the Emperor Fu Hi, B. C. 2956. Baumeister (Denkmäler) says it was known in Homeric times; excavations in Crete show that in the recently uncovered civilization of its people the balance was used; Egyptian hieroglyphics show it in ancient use. As the beam was commonly of wood it has not been preserved from those early days.

But why should people desire a more objective, more honest, means of comparing things than by "hefting" or counting? I take it, because of trade, whose routes were marked in Europe even in the Stone Age (as is known from the migration all over the continent of flints of identifiable origin). When the trade in metals grew up, accuracy and standards became of an importance hitherto unprecedented and with them arose the balance and calibrated weights. Lepsius[2] is referred to as figuring a sliding weight on a balance beam of ancient Egypt; I have not seen the figure; one would assume that such a sliding weight, serving perhaps as a handy tare, might have suggested the next improvement in weighing apparatus, the steelyard. Whether it did or not must remain for a while unknown; for the only authorities accessible to me are irreconcilably in contradiction as to the date earliest recorded of the Roman steelyard.

There are two forms of steelyard, the Danish and the Roman. The former seems once to have been very common. Sökeland[3] describes a large variety, from simple clubshaped sticks to elaborately worked metal pieces. It was slung by a cord; the unknown weight hung from another cord fixed near one end, and the more or less heavy knobbed or swelling end beyond the fulcrum balanced the unknown.

[1] *Jour. Roy. Anthrop. Inst.*, 47, 1912.

[2] Denkmäler, III., 39, No. 3.

[3] Translated in Smithsonian Annual Report, 1900, p. 551.

In weighing the fulcrum was shifted from place to place, and there were notches for the suspending cord, determined, no doubt, with known weights, these having been calibrated with the balance. This Danish steelyard, desemer or bismar had, then, a graduated beam whose graduations followed no observable law and were wholly empirical. It is this that Aristotle discusses in his "Mechanical Problems," though without much success.

The Roman steelyard, "Statera Romana," familiar in modern form and but little improved since classical antiquity, appeared first perhaps in Egypt, perhaps in Campania. I can only quote authorities.

F. Müller:[4]

B.C. 1350. The steelyard with running weight is in use among the Egyptians.

L. Darmstaedter:[5]

B.C. 1400. The steelyard with running weight is in use at the time of the Egyptian king Amenophis IV.

F. M. Feldhaus:[6]

Unequal armed balance with running weight, usually called Roman steelyard. This balance has a short arm, on which the weighing pan hangs, and a long arm, bearing a graduation and notches for suspending a running weight. The steelyard is known to have been in use in Egypt about B.C. 1400.

Against these very definite statements must be set the authority of Sir J. G. Wilkinson[7] and of Dr. L. W. King and Flinders Petrie,[8] and of all others, as far as I know, who have published on the subject or answered my inquiries about it, to the effect that the Egyptians did not have the steelyard till the Roman period. Harper's "Book of Facts" (1905) says that it is mentioned B.C. 315—I do not know by whom.

Incidentally, I may say that I was not a little surprised to find this contradiction, and that so well known an instrument of trade should have so uncertain an origin.

I will assume that the Roman steelyard dates back to B.C. 400, and was then known through Mediterranean civilization. He who first graduated it may be called the true discoverer of the law of moment equilibrium, the law of the lever. With any pry or crowbar, or with the bismar, one would have to search for the law deliberately; but this improved weighing apparatus made for trade purposes displays its law to the eye. I imagine the inventor as using a bismar beam, but keeping the fulcrum fixed and sliding along a rider weight, calibrating the beam by means of known balance weights in the pan. The unaided eye could see that equal added weights in the pan corresponded to equal increments of length on the graduation; and so we may understand how Aristotle (B.C. 384–322), long before Archimedes (B.C. 287–212), was able to state the law thus "[9] . . . as the weight moved is to the weight moving it, so, inversely, is the length of the arm bearing the weight to the length of the arm nearer the power. . . ." This he attempts to demonstrate as a consequence of the properties of the circle, but with poor success.

Archimedes, knowing this law of the lever, wrote a book on the subject, unfortunately lost. Another book of his has come down to us, in which he discusses the subject of balanced bodies and the location of centers of gravity in certain plane figures. He does not define *center of gravity*, but from the use he makes of the term in his demonstrations it is clear that he means by it the point where a body balances when there suspended. This point he treats as representative of the body, and assuming this he attempts a demonstration of the law of the straight horizontal lever, or law of moment equilibrium. E. Mach[10] points out, however, that this demonstration, superficially convincing, is seen to be fallacious

[4] "Zeittafeln zur Geschichte der Mathematik," etc., p. 3 (1892).

[5] "Handbuch zur Geschichte der Naturwissenschaften," etc., p. 3 (1908).

[6] "Die Technik," p. 1251 (1914).

[7] "Manners and Customs of the Ancient Egyptians" (1878).

[8] Quoted by H. L. Roth, *l. c.*

[9] "Questiones Mechanicæ," E. S. Forster, trans. (1913).

[10] Science of Mechanics," McCormack trans., p. 18 (1902).

when one attempts to define more closely the concept *center of gravity*. For the law of the lever then appears as implicitly assumed in this concept, and hence not to be demonstrated by its use.

Our knowledge of Archimedes's attainments is limited to the scanty remnants which generations of militariste have allowed to survive. An examination of Aristotle's "Mechanical Problems" shows that even before Archimedes certain phenomena of the simplest machines were puzzling, that the effort-demanding quality of bodies presented itself in two aspects. Aristotle says (Ch. 10):

> Why is it that a balance moves more easily without a weight upon it than with one? So too with a wheel or anything of that nature, the smaller and lighter is easier to move than the heavier and larger. Is it because that which is heavy is difficult to move not only vertically but also horizontally? For one can move a weight with difficulty contrary to its inclination, but easily in the direction of its inclination; and it does not incline in a horizontal direction.

Again (Ch. 19):

> How is it that, if you place a heavy axe on a piece of wood and put a heavy weight on the top of it, it does not cleave the wood to any considerable extent; whereas, if you lift the axe and strike the wood with it, it does split it, although the axe when it strikes the blow has much less weight upon it than when it is placed on the wood and pressing on it? Is it because the effect is produced entirely by movement, and that which is heavy gets more movement from its weight when it is in motion than when it is at rest? So, when it is merely pressed on the wood, it does not move with the movement derived from its weight; but when it is put into motion, it moves with the movement derived from its weight and also with that imparted by the striker. Furthermore, the axe works like a wedge; and a wedge, though small, can split large masses, because it is made up of two levers working in opposite directions.

P. Duhem,[11] comparing the methods of the two great Greeks, says:

> Admirable as a method of demonstration, the path followed by Archimedes in mechanics is not a method of invention; the certainty and the clarity of his principles stick on the whole where they are plucked, so to speak, on the surface of phenomena, and are not pulled up by the roots from the bottom of things; according to a remark which Descartes made less justly about Galileo, Archimedes "explains very well *what is* so, but not *why it is so*," therefore we shall observe the more striking forward steps in statics to start rather from the doctrine of Aristotle than from the theories of Archimedes.

But one should not look to the "Mechanical Problems" for demonstrations by an admirable method; they are but poor attempts at demonstration, from the hand of one of whom Duhem[12] writes:

> Aristotle was not a geometer; from the principle which he had set up, he did not know how to draw with entire rigor all the consequences which can be deduced from it.

Attempts at demonstration, moreover which have doubtless suffered by transcription a hundredfold repeated, and at the hands of teachers and pupils who were merely Aristotelians. Unable successfully to solve his problems, he has yet the great merit, greater than that of a mere problem-solver, of perceiving the existence of the problems, and putting forward a statement showing the difficulty.

He for whom his most famous pupil, the conquering explorer Alexander, made collections of natural history, sending them far by the slow transport of those days to his master's school of science, was no pedant of the schools. He knew the mint, the market and the quarry; he saw the balance pans easily swinging when empty, but, loaded with metal or meat and balanced, hard to set in motion; he thought it odd that balanced weights, which, so to speak, lift each the other,[13] should be hard to move; he saw the cylindrical column sections rolled with labor up inclined planes out of the quarry, but rolling down again at a touch; why should they be hard to

[11] "Les Origines de la Statique," p. 12 (1905).

[12] *Loc. cit.*, p. 8.

[13] "Q. M.," Ch. 26. "Why is it more difficult to carry a long plank of wood on the shoulder if one holds it at the end than if it is held in the middle? . . . The reason is, that if one lifts it in the middle, the two ends always lighten one another, and one side lifts the other up."

roll on a level, though then neither descending nor ascending? "Is it because that which is heavy is difficult to move not only vertically, but also horizontally?" Is it because things require an effort not only for lifting them, but also for setting them in motion?

He is evidently groping; his difficulty is, that he fails to analyze the meaning of the phrase, *easy to move,* or, *to move easily.* A thing is easy to move when with a slight effort in a short time we change its speed considerably, or give it a large acceleration; it is hard to move when we must exert a considerable effort to produce the same total change in speed, or a slighter effort for a longer time, then giving it only a small acceleration. He has not distinguished clearly the elements *inertia,* of which *mass* is the quantitative measure, and *acceleration,* or rate of change of speed; but he does see that there is a fundamental distinction between accelerating a body in the horizontal direction, the direction in which its motion is unaffected by weight, and accelerating it in the vertical direction, when the weight hindrance is superposed on and confused with the difficulty of acceleration. His observations being merely sensuous and qualitative, he could not know by measurement the constancy of gravitational acceleration, nor could he escape from the confusion of weight and mass which this same constancy made inevitable.

Again, watching the woodman and his axe, Aristotle knew that effort exerted as steady pressure would not cleave the block, though when swung through the air the blade split the wood instantly. It seemed odd to him that a continuing effort without motion should be unable to achieve an end so easily reached by an effort no greater used to produce motion of the axe.

> Is it because . . . that which is heavy gets more movement from its weight when it is in motion than when it is at rest?

For *movement* read here *momentum,* or use Newton's phrase, *quantity of motion,* and read *mass* for *weight,* and the query sounds much more modern, though not yet quite clear. He was again groping after distinctions later grasped by Newton. In his observation there was, of course, nothing new; upon such the arrow-maker's craft was built millennia before Aristotle; but he was perhaps the first to record a feeling of perplexity concerning them.

In another place (Ch. 31) Aristotle asks:

> Why is it that a body which is already in motion is easier to move than one which is at rest?

This evidently deals with running and starting friction. His answer is very unsatisfactory; but this query, as do one or two others, touches on the nature of friction, that other obstacle which for ages prevented the development of a science of mechanics.

I have no doubt that these two facts in terrestrial experience, the universality of friction and the practical constancy of gravitational acceleration, were not only the chief causes of the slow development of mechanics, but are also to-day among the main reasons why so many, perhaps most, of our athletically and mechanically wise students not only fail to comprehend the laws of motion—they simply do not believe they are so. They are confirmed Animists; to imagine a force acting, they must imagine themselves acting right there, or the agent feeling as they would in its place. They do not believe in a natural tendency of things to keep on going, and acceleration is to some of them a concept of inaccessible refinement. "To describe the motions which occur in nature, in the simplest way," or otherwise than in terms of their own effort sensations is a problem of small interest. And with the phenomena thus sensuously described, to them a body is hard to throw *because* it is heavy. From qualitative experiences, such as their predecessors since and before the Stagyrite have had in fulness, they will never gain conviction of the truth. Experiments must be devised and set before them to induce in them the perplexity Aristotle felt in presence of the loaded balance and the rolling cylinder; for this feeling of perplexity, and a revolt against it, are the beginning of science; then they must resolve this perplexity by experiments and study which will lead them

along the path of Leonardo, Kepler, Galileo, Huygens and Newton.

WILLARD J. FISHER

WORCESTER POLYTECHNIC INSTITUTE,

THE SCIENTIFIC MEMBERS OF THE BRITISH EDUCATIONAL MISSION

As has been noted in SCIENCE, the British government, on the invitation of the Council of National Defense, has sent to the United States a distinguished mission to inquire into the best means of procuring closer cooperation between British and American educational institutions, to the end, greatly desired on both sides, of making increasingly firm the bonds of sympathy and understanding that now unite the English-speaking world.

The members of the mission are:

Dr. Arthur Everett Shipley, vice-chancellor of the University of Cambridge, master of Christ's College and reader in zoology.

Sir Henry Miers, vice-chancellor of the University of Manchester and professor of crystallography.

The Rev. Edward Mewburn Walker, fellow, senior tutor and librarian of Queen's College, member of the Hebdomadal Council, Oxford University.

Sir Henry Jones, professor of moral philosophy, University of Glasgow.

Dr. John Joly, professor of geology and mineralogy, Trinity College, Dublin.

Miss Caroline Spurgeon, professor of English literature, Bedford College, University of London.

Miss Rose Sidgwick, lecturer on ancient history, University of Birmingham.

The proposed itinerary of the mission follows:

October 8–14—New York.
" 15–17—Washington (Mt. Vernon).
" 18—Baltimore.
" 19–21—Philadelphia (Bryn Mawr, Haverford).
" 22–23—Princeton.
" 24—New York (Vassar).
" 25–26—New Haven.
" 27—Amherst, Smith, Mt. Holyoke.
" 28–30—Boston and Cambridge (Wellesley).
" 31–
November 2—Montreal (Ottawa).
" 3– 5—Toronto (Niagara Falls).
" 6—Ann Arbor.
" 7–12—Chicago (Urbana, Evanston).
" 13–14—Madison.
" 15–17—Minneapolis and St. Paul.
" 18—Des Moines (Ames).
" 19–20—St. Louis.
" 21—Cincinnati.
" 22—Lexington, Ky.
" 23—(Louisville).
" 24—Nashville.
" 25–28—New Orleans (Houston, Austin).
" 29–30—Tuskegee.
" 31—Chapel Hill.
December 1—Charlottesville.
" 2—Washington.
" 4– 7—Boston and Cambridge.

The British Bureau of Information has prepared a statement concerning the members of the mission, and we give the biographical sketches of the scientific members.

DR. ARTHUR EVERETT SHIPLEY

Arthur Everett Shipley, Sc.D., vice-chancellor of the University of Cambridge, is well known in the United States, in which he has on several occasions been an honored guest. He is an honorary D.Sc. of Princeton University, foreign member of the American Association of Economic Entomologists and of the Helminthological Society of Washington. Dr. Shipley is a member of the Central Medical War Committee of Great Britain. He holds many offices of great responsibility, being, for example, a trustee of the great collection of specimens illustrative of many branches of science which was made by John Hunter, purchased by the government after his death in 1793, and presented to the Royal College of Surgeons; a trustee of the Tancred Foundation established by Christopher Tancred (1689–1754) of Whixley Hall in the County of York, to provide studentships in divinity and in physic; a trustee of the Beit Memorial Fund for fellowships for medical research; chairman of the Council of the Marine Biological Association; vice-president of the Linnæan Society; member of the Royal Commission on the Civil Service. In 1887 he was sent to the Bermudas by the Colonial Office to investigate a plant disease. He was also commissioned by the

British government to investigate grouse disease, and the volume on "Grouse in Health and Disease" which he published records many observations regarding the pathology of birds. He is a fellow of the Royal Society.

Dr. Shipley's writings on many branches of zoology and other subjects, historical, architectural and biographical, are too numerous for mention. They include several standard textbooks of zoology. The study of parasitical animals is his especial hobby. Since the commencement of the war he has written two books of extraordinary interest and humor, on a subject which, if less skilfully handled, would be generally regarded as repulsive—lice, bugs, fleas and flies—little animals which in all former wars have contributed to the failure of armies in almost as large a measure as swords or guns. But for recent knowledge of their habits the havoc which they have worked in this war, already sufficiently serious, might have been the determining factor. "The Minor Horrors of War" and "More Minor Horrors" are books which may be read with pleasure by the least scientifically inclined of men and women.

As master of Christ's College, Dr. Shipley inhabits a "lodge" which the foundress, the Lady Margaret, mother of Henry VII., once occupied. The lodge, like all similar houses, had been altered to suit the taste of each succeeding age. The new master immediately after his election devoted much money and antiquarian knowledge to its restoration to something like its original condition. Soon after the commencement of the war he turned the house into a convalescent home for wounded officers, several hundreds of whom have since lived with him. In other forms of war work he has also been very active, especially in the collection of clothes for Belgian refugees, and the maintenance and education of Serbian boys, for which the members of the university, with great generosity, made themselves responsible.

SIR HENRY MIERS

Sir Henry Miers was born in South America, where his father was an engineer (as his grandfather had been before him), but was brought to England at the age of two. One of his great-grandfathers was Francis Place, the self-educated politician who was a leader in the reforms of 1824–1841.

He was educated at a private school near Oxford, where among his schoolfellows were the late Lord Parker, of Waddington, and George Macmillan, whose firm is well known in the United States. Thence he went with a scholarship to Eton, and was there for five years. The course at Eton was almost purely classical, but Miers did a considerable amount of science and mathematics out of hours, winning school prizes in these subjects among others. He also won the gold medal in geography offered at that time by the geographical society for competition among public schools; among the honorably mentioned on that occasion was his schoolfellow Cecil Spring-Rice, afterwards ambassador to the United States. Lord Curzon was also one of his exact contemporaries at Eton.

In 1877 he went with a classical scholarship to Trinity College, Oxford, and read double (classics and mathematics) for the first degree examination, and double (mathematics and physics) for the final examination. But he left Oxford before the final examination in the science school in order to prepare for a position which was about to be established in the mineral department of the British Museum. His interest in mineralogy had been stimulated at Oxford by Professor Story-Maskelyne, whose lectures he attended. The professor was then a member of parliament, and came up from London to lecture to Miers, who was for a time his only pupil. He also worked at the subject in the long vacation at Cambridge and in other vacations at the British Museum.

At the British Museum he was a first-class assistant for twelve years, and during that period published about fifty scientific papers. His teaching experience also began in London, for he was invited by Professor Armstrong to start the teaching of crystallography at the neighboring Central Technical College (which has now been absorbed in the Imperial College of Science and Technology). This continued for about nine years, when he was succeeded

by one of his first pupils, W. J. Pope, who is now professor of chemistry at Cambridge.

One of his adventures during the period of his assistantship at the British Museum was an attempt (in 1888) to make a balloon voyage to Vienna in company with Simmons, a well-known aeronaut, and a gentleman named Field. On approaching the coast of Essex it was thought prudent to descend, as the wind was in a too-northerly direction. The balloon, which was a very large one, was safely anchored to a tree. and the occupants of the car fell about sixty feet. Simmons was killed and Field had both legs broken. Miers, although severely bruised, sustained no permanent injury.

In 1895 a letter which he wrote to Sir William Ramsay, immediately after the meeting of the Royal Society at which Ramsay and Rayleigh announced the discovery of argon, advising him to examine the mineral cleveite for compounds of argon, led to the unexpected discovery of helium.

In the same year Miers gave some lectures for Story-Maskelyne at Oxford, and in 1896 succeeded him, on his retirement as Waynflete professor of mineralogy, becoming thereby a fellow of Magdalen College, where he lived for the next twelve years.

At Oxford he created a department of mineralogy, developed a small school of research, and published a number of papers of which the more important (mostly in conjunction with Miss F. Isaac) related to spontaneous crystallization. Among his other pupils were Dr. Herbert Smith, of the British Museum, Dr. H. L. Bowman, who succeeded him as professor, Mr. T. V. Barker, now university lecturer in crystallography, the Earl of Berkeley and his scientific colleague, Mr. E. G. Hartley. In 1902 he published a text-book on mineralogy which has been much used in the United States.

He took a considerable share in the administration of the university, and was a member of the Hebdomadal Council and a delegate of the University Press. In 1902 he succeded the late Sir E. B. Tylor, the anthropologist, as secretary of the University Museum, becoming thus responsible for its administration.

In 1908 he became principal of the University of London, in succession to the late Sir Arthur Rücker. During the greater part of his period of office the Royal Commission on University Education in London was taking evidence, and its report, recommending a large scheme of reconstitution, was only published in 1913.

Among the many activities of the university he associated himself especially with the tutorial classes for working people, with whom his ready speech and never-failing humor made him exceedingly popular. His lectures at the Working Men's College, which was founded some seventy years ago by Maurice, Tom Hughes (the author of "Tom Brown's Schooldays") Furnivall and Westlake, were events to be remembered. He also tried to gather up the scattered units of the very complicated University of London, such, for example, as the College of Household and Social Science for Women, the Officers Training Corps, and the University Club.

He assisted Mr. Albert Kahn to establish his British Traveling Fellowships, and instituted a board of trustees, of which he became a member and secretary, consisting of the Lord Chancellor, the speaker, the Lord Chief Justice with Lords Curzon and Milner as coopted members. Most of the American Kahn Traveling Fellows visited him in London at the commencement of their journey.

He was mainly instrumental in bringing about the Congress of the Universities of the British Empire, which met in 1912, and was to have met again in five years. This was prevented by the war, but the universities bureau has come into existence as the result of the Congress and will organize the next Congress when the opportunity arises.

In 1915 it was clear that the war would prevent any immediate reoganization of the University of London, and Miers therefore accepted the invitation of the University of Manchester to become its vice-chancellor. In Manchester he is already associated with many educational and civic activities outside the university; he is chairman of the Joint Matric-

ulation Board, which determines the admission of students to the five northern universities and examines and inspects secondary schools in their areas of influence; also of the Manchester Royal College of Music, of the Manchester Royal Institution, and of the newly formed northern branch of the National Library for the Blind.

He has been for many years a fellow and governor of Eton College, and fellow of Magdalen College, Oxford; was elected a fellow of the Royal Society in 1896; has been president of the Mineralogical Society, and of the Geological and Educational Sections of the British Association; is an honorary doctor of the universities of Sheffield and Christiania; was knighted in 1912; was a member of the treasury committee which reported on the reform of the Civil Service Class I examinations; and is a member of the committee appointed by the prime minister to report on adult education.

During and since college days he has devoted most of his vacation to foreign travel. In 1892, while assistant at the British Museum, he visited and reported on the public and private mineral collections of Norway, Sweden and Russia and part of Germany.

In 1901 he joined Professor Coleman of Toronto in Canada for a journey of exploration in the northern Rockies, but at the invitation of the Canadian Minister of the Interior changed his plans and visited and reported on the gold mines of Klondike, in company with Professor Coleman. He had previously visited Canada and the Pacific coast with the British Association (spending some weeks also in the United States) in 1897; and was there again with the International Geological Congress in 1913.

He visited a great part of South Africa on the invitation of the Rhodes trustees and the Johannesburg Council of Education in 1903, and was personally concerned in the first appointments made in the Transvaal Technical Institute which afterwards became the Transvaal University College. A second visit to South Africa with the British Association took place in 1905.

Many of his European journeys have been made to places which possess public or private collections of antique sculpture, in which he is interested.

DR. JOHN JOLY

John Joly, M.A., B.A., Engineering, D.Sc., has been professor of geology and mineralogy in the University of Dublin for the past twenty years. He was born in Ireland in 1857 and educated at Trinity College, in which he held various subordinate posts before his appointment to the chair which he now occupies.

For more than thirty years he has carried on research in physics, and especially in the application of physics to engineering, but his exceedingly ingenious mind has led him down many by-paths in search of the solution of problems of general interest.

One of his earliest inventions was the steam calorimeter, by means of which he succeeded in determining directly the specific heats of gases at constant volume. This was a problem in experimental science which had long baffled physicists. Having invented the calorimeter, Joly turned it to excellent account in the examination of a variety of gases over a wide range of pressure and temperature.

Distinguished as a physicist, he is more widely known as a pioneer in the modern method of photography in colors. He was the first in 1897 to take successful photographs in natural colors by the use of a minutely-subdivided screen carrying the three primary colors. On a plate exposed behind this screen he obtained, in effect, three negatives on the same plate. A transparency made from this plate, when placed in an optical lantern behind a screen similarly ruled in red, green and blue lines, displayed the objects photographed in their natural colors. This experiment led, ten years later, to the development of the well-known and very efficient Lumière process on which colored starch grains are substituted for Joly's colored lines.

The ascent of sap in trees is another subject which has occupied his attention, in conjunction with Henry H. Dixon, the professor of botany of Trinity College. He offered a simple

explanation of this phenomenon. The theory then put forward attributes the ascent of the sap to transpiration from leaves of the tree and the tensile strength or cohesion of the fluid in its capillary tubes.

Another matter of very great general interest was dealt with by Joly when he determined the age of the ocean by estimating the amount of common salt carried to it by the rivers and calculating the length of time that must have elapsed in order that the salt in sea water should have acquired its present concentration.

Sections of various kinds of rock show remarkable little rainbow-colored circles. Joly was the first to prove that these rainbow-like circles or pleo-chroic haloes occur about particles of salts of the rare metals uranium and thorium; metals which are always undergoing decomposition into elements of lower atomic weight. The haloes are due to the bombardment of the substance of the rock by the radioactive particles discharged from the heavy elements. The rate of transformation of uranium and thorium into these radio-active substances being known, it has been possible to calculate the length of time necessary for the formation of the haloes and therefore the age of the rocks.

Joly has been a pioneer in the applications of radio-activity to geological phenomena, *e. g.*, the origin of mountain ranges.

The late Professor Lowell's book on Mars led Jolly to offer a relatively simple explanation of the canals of Schiaparelli. He attributed them to the gravitational effects of small satellites falling into the planet.

Even biological problems have engaged the versatile professor's attention. In a book entitled "The Abundance of Life" he submits a dynamic basis for evolution.

His interest in radio-activity led him at an early date to suggest the insertion of radium into cancers, and recently—in conjunction with Captain William Stevenson, R.A.M.C.—he suggested the use of emanation needles, which he invented, for therapeutic purposes.

Joly has for many years been a keen yachtsman, and recently has devoted much time to problems connected with submarine warfare. He has suggested many applications of modern science to navigation, and especially those dependent upon the principles of synchronous signalling.

In his own university Professor Joly is known as a reformer, being largely responsible for various recent changes. He became secretary to the Academic Council on the death of Professor Edward Dowden, the Shakespearean scholar.

During the rebellion in 1915 he took an active part in the defense of the college. An account from his pen of this episode appeared in *Blackwood's Magazine*. He is a commissioner of Irish Lights. He is warden of the Alexandra College for Women. For many years he has been secretary of the Royal Dublin Society. He is a fellow of the Royal Society. In 1910 he received from the society a royal medal. In 1911 he received a royal medal from the Royal Dublin Society.

Among his many publications are to be noted —"Radio-activity and Geology," "Synchronous Signalling in Navigation," "The Birth-time of the World," and a vast number of contributions to various scientific journals, notably to the *Philosophical Magazine*, of which he has been one of the editors for many years.

WILLIAM JOHN KEEP

William John Keep, consulting engineer for the Michigan Stove Company, manufacturer of testing machines and writer on foundry topics, died on September 30. He was born in 1842, at Oberlin, Ohio, and studied at Oberlin and at Union College, where he was graduated in 1865 with the degree of civil engineer. For several years during his residence in Troy he gave a course of lectures on the steam engine to the senior class of the Rensselaer Polytechnic Institute.

During all his life Mr. Keep was very much interested in experimental tests with cast iron and other metals. In 1885 he discovered the relation between the shrinkage and chemical composition of cast iron and devised the systems of "Keep's Test," which he later named "Mechanical Analysis." This is used largely in the United States and other countries instead of chemical analysis. His

method was devised as the result of many thousands of tests described in numerous papers on the influence of silicon, phosphorus, sulphur and manganese on cast iron, on shrinkage, strength and impact of cast iron, "Keep's Cooling Curves," aluminum, etc.

His most important publication is his book "Cast Iron" (John Wiley and Sons, 1902). He was also author of a large number of scientific papers, most of which are printed in the transactions of the different organizations to which he belonged. At the time of his death he had just finished a paper "Static and Dynamic Tests with Transverse Test Bars," which gives a description of his later experiments and which will be published. Mr. Keep patented many of his devices, one of the most important of which is a system of matchplates for foundry use. His testing machines are well known, also his apparatus for "Mechanical Analysis." He was a member of the American Society of Mechanical Engineers, (vice-pres. 1903–5), American Institute of Mining Engineers, Iron and Steel Institute of Great Britain, International Association for Testing Materials, American Foundrymens Association, Franklin Institute, Detroit Engineering Society (past pres.), fellow of the American Association for the Advancement of Science, honorary member of the Rensselaer Society of Engineers and of the Foundrymen's Association of Philadelphia.

SCIENTIFIC EVENTS

SCIENCE AND INDUSTRY IN TASMANIA

Mr. W. H. Twelvetrees, government geologist in Tasmania, reports to the British Science Guild that the Tasmanian State Committee of Science and Industry has started the discussion of several subjects which can be usefully considered at the present juncture. Small working committees have been formed to deal with the questions of fuel, alcohol, improvement of seeds, tuberculosis in stock, utilization of kelp and Irish blight.

The committee has drawn up a scheme in regard to the study of problems connected with the realization of forest products. The scientific subjects for investigation are particularized as:

1. The production of wood pulp, cellulose, etc., by the disintegration of the main body of the timber.
2. The production of volatile and essential oils by the distillation of the leaves and twigs.
3. The production of a potash fertilizer from the ash obtained from the burning of the leaves and twigs.
4. The production of dyes, tannins, etc., from the various parts of the wood and possibly from the leaves.
5. The production of various distillation products from the waste timber and the conversion of same into higher priced materials for which markets could be found in different parts of the world.
6. The production of building materials from the sawdust and wood after breaking down into pulp; probably after chemical treatment for the removal of various soluble organic materials in the wood, such as lignin, hemicellulose, etc.

The state committee, without neglecting other subjects, has decided to specialize for the present on the forest industry generally. Its investigations are expected to indicate where and how the large timber areas in Tasmania can be improved, and profitable industries initiated. The committee has urged the Commonwealth Advisory Council to call delegates of the various state committees together so as to coordinate the work of carrying out a general scheme, but the council being only a provisional institution is of opinion that general research on forest products had better wait till a forest products laboratory is established under the permanent institute. In the meantime, specific research will be supported by grants-in-aid.

The production of electrolytic zinc by means of current supplied by the state hydro-electric installation is proceeding satisfactorily at Risdon, near Hobart. The chairman of the company announces that the establishment of this industry in Tasmania has been owing to a desire to prove the application of the electrolytic process to Australian ores and concentrates for the production of munition zinc,

hitherto produced within the empire in only small quantities, thus helping to make the empire self-contained as regards most important items for defence and commerce. The small plant which has been started has been putting out regularly 600 pounds of zinc per day for the last eight or nine months: and now a new 10-ton plant has been installed, permitting a production of 15 tons daily. The ultimate size of the plant at Risdon for the production of zinc is expected to have ten times the capacity of the present unit. It is also hoped to turn attention by and by to other industries made possible by the government hydro-electric undertaking. The success of the enterprise at Risdon will, it is confidently anticipated, favorably affect the zinc industry of the empire.

MANGANIFEROUS ORE IN OREGON

Deposits of manganese and manganiferous ores in many parts of the United States have been examined during the last two years by geologists of the United States Geological Survey, Department of the Interior. This is essential work, because the limitation of shipping facilities has reduced the imports of manganese ore from other sources than the West Indies and Central America in 1918 nearly one third below those of 1917 and there is a prospect that they will be still further reduced in 1919. The importation of the iron-manganese alloy ferromanganese has decreased in much greater proportion and probably will soon be stopped altogether. To offset these decreases in the supply of manganese the Geological Survey has assisted in stimulating the domestic and the near-by foreign production by examining the manganese deposits in this country and in the West Indies with the view of determining the availability of the ore. The producers of domestic manganese ore have responded actively to the call made on them and have increased their production from 27,000 tons in 1916 to 116,000 tons in 1917. It now appears that the production of ore in 1918 will be 185,000 tons.

Manganese is used in various ways. Metallic manganese in the form of ferromanganese is alloyed with steel to make manganese steel and manganese dioxide is used in the manufacture of dry batteries, in glassmaking and in the chemical industries. Manganese, however, is used principally in making all Bessemer and open-hearth steels, in which it is incorporated in the form of iron-manganese alloys, which will serve as deoxidizers and purifiers of the molten metal. More than 95 per cent. of all the manganese consumed in this country is used for this purpose.

An examination of several manganiferous deposits in Oregon, including a reconnaissance of 150 square miles near Lake Creek, Oregon, was made in July, 1918, by J. T. Pardee, a geologist of the United States Geological Survey, Department of the Interior, in company with Henry M. Parks, Director of the Oregon Bureau of Mines and Geology. Mr. Parks has kindly placed at the disposal of Mr. Pardee the results of his previous work in this area, and Messrs. Parks and Pardee are jointly responsible for the estimates and conclusions here given.

So far as known the manganiferous deposits of the Lake Creek district are confined within an area of about 150 square miles in the east-central part of Jackson county, Oregon. The area is rather sparsely settled, and farming is the principal industry. The nearest large town is Medford, which is 15 miles directly southwest of the deposits but nearly twice that distance by the available roads. Eagle Point, a town on the Pacific & Eastern Railway, is the most convenient shipping point. The surface of the region is hilly and in places mountainous, but only moderately rugged. The local relief ranges from a few hundred feet to 2,000 feet or more, and the general elevation is between 2,000 and 2,500 feet. Streams are numerous, though most of the smaller ones become dry in summer. The climate is mild and the year is made up of a wet and dry season, corresponding to winter and summer. Most of the rather heavy winter precipitation falls as rain. The greater part of the surface that lies below 2,500 feet is covered with a mixed growth of madrona, manzanilla, and chapparal bushes and rather

scrubby oaks. At higher elevations fir and pine tres are abundant.

The area is underlain by igneous rocks that appear to be chiefly basaltic and andesitic flows and tuffs. The sequence of the rocks in part in the Lake Creek district comprises, beginning with the lowest flow, a platy basalt, 500 feet or more thick; a red basalt tuff, commonly manganiferous, 100 to 300 feet or more thick; a platy basalt, a few feet to 100 or more feet thick; dark gray to buff,locally manganiferous, andesitic tuffs and breccias, a few feet to 500 feet thick; vesicular to compact massive gray and purplish gray andesitic flows and tuffs, about 500 feet thick; and dense black basalt that weathers light gray on the surface, a few feet to more than 100 feet thick.

About 1,500 tons of ore, containing at least 15 per cent. of manganese, is "in sight." In addition, incomplete prospecting by drilling and by open cuts indicates that at least 4 acres are probably underlain by 10 feet of ore (about 120,000 tons) containing probably 10 per cent. of manganese. The surface indications in other parts of the district warrant an estimate that they may yield 130,000 tons more of material carrying at least 10 per cent. of manganese, so that the probable reserves of ore of this grade amount to at least 250,000 tons.

EXHIBIT OF MINERALS USEFUL IN WAR

Graphically displayed in the Hall of Minerals of the American Museum of Natural History is a series of minerals intended to visualize the steps necessary in the development of war munitions from the crude ore to the finished product, and to point the urgent need of domestic production. Included in the exhibit are the rarer minerals such as mercury, nickel, manganese, chromium, tungsten, vanadium and molybdenum, and under each specimen of these a label indicating in what particular industry it is used. For instance we find molybdenum steel is used in the construction of the inner tubes of large guns, as it has been found that this metal best resists the erosion caused by the gases developed by smokeless powder.

There are also displayed small distribution maps showing the occurrence of the ores in the United States and other countries, giving locations of the principal supplies prior to the war, and indicating regions in this country worthy of development. Particularly interesting is the display of finished products. Through the courtesy of a number of prominent manufacturers, material has been secured which illustrates how these minerals and metals are extracted and are being turned into tools for our army forces. By this means one can trace the application of mercury from cinnabar—how the primers are charged with fulminate of mercury which explodes the hand and rifle grenades now being so successfully used in pushing back the Teuton forces. One may also see a sectional barrel of the three-inch naval gun with its lining of molybdenum steel. Also interesting and instructive is the series showing the many stages required in the manufacture of a completed nickel-jacketed bullet like those now being used by thousands in our rifles, machine guns and revolvers.

Stamped on the lead insert of the .303 caliber cartridge used in the Lee-Enfield rifle of the British Army, are the letters "U. S.," which must have served as a reminder to the Kaiser's troops, in the early part of the war, that these particular arguments were made in the United States. Another display makes comparison of these modern messengers of death with those in use during our Civil War.

LIBRARY OF THE EDGEWOOD ARSENAL LABORATORY

Major Wm. Lloyd Evans, Chemical Warfare Service, has addressed the following letter to Colonel Wm. H. Walker, commanding officer:

As we are becoming more settled in our laboratory work, the need for the well-known handbooks and chemical journals becomes more apparent daily. We are badly in need of such works as Beilstein's *Organische Chemie*, Landolt-Börnstein, *Tabellen*, *Journal of the American Chemical Society*, *Journal of Industrial and Engineering Chemistry*, *Metallurgical and Chemical Engineering*, *Journal of the Society of Chemical Industry*, *Transactions*

of the American Society of Testing Materials, Transactions of the American Electrochemical Society, and many others that readily suggest themselves. Through the kindness of the duPont Company, of Wilmington, we have been able to locate the owners of a few of these desirable works, but as you can readily imagine they are very difficult to obtain. You will be happy to know that Dr. Ira Remsen has offered us his *Gmelin-Kraut* as a loan.

It has occurred to me that a notice placed in the *Journal of Industrial and Engineering Chemistry* and also in SCIENCE, explaining the needs of this laboratory, might bring forth loans of books we greatly desire. If the commanding officer, Edgewood Arsenal, concurs in this view, might I respectfully suggest that this notice be asked for, and that all communications in reference to the same be made to the commanding officer, Edgewood Arsenal?

Colonel Walker has approved the suggestion and has authorized the publication of the letter. He will be glad to receive books loaned to the laboratory and to return them without damage at the end of the war. In case of damage or loss involving any or all of the books the Edgewood Arsenal assumes liability up to 150 per cent. of the original price. The cost of packing and shipping the books to and from Edgewood Arsenal will be borne by the government.

ENDOWMENT FOR ENGINEERING RESEARCH

AT a joint meeting of the trustees of the United Engineering Society with the Engineering Foundation Board in New York on October 7 announcement was made that Ambrose Swasey of Cleveland, Ohio, had given the Engineering Foundation an additional $100,000 for endowment of engineering research.

Mr. Swasey, who is a past-president of the American Society of Mechanical Engineers, is well known as a designer and builder of large telescopes and other optical instruments and fine machine tools. In 1915 he gave $200,000 for engineering research, so that the total endowment is now $300,000. Mr. Swasey's original gift made possible the establishment of the Engineering Foundation by the United Engineering Society, representing the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. His gifts have been inspired by his conviction of the necessity for research in engineering science not only in connection with the war but for keeping the United States in the forefront of nations in industrial development. This latest gift is an expression of Mr. Swasey's appreciation of the war service which the United Engineering Society and the Engineering Foundation have rendered to the country.

SCIENTIFIC NOTES AND NEWS

DR. VERANUS A. MOORE, head of the New York State Veterinary College at Cornell University, was elected president of the American Veterinary Medical Association at the annual meeting held recently in Philadelphia.

DR. A. E. KENNELLY, of Harvard University and the Massachusetts Institute of Technology, has recently returned from a trip overseas during the summer on special duty for the United States Army Signal Corps.

LIEUTENANT COLONEL WILLIAM H. WELCH, of the Johns Hopkins Medical School, now attached to the surgeon-general's staff at Washington, is recovering from an attack of influenza.

LIEUTENANT COLONEL THOMAS R. BOGGS, Baltimore, has been made chief medical consultant for the air service of the American Expeditionary Forces, attached to general headquarters.

CAPTAIN MADISON BENTLEY is now president of the Aviation Examining Board, examining aviation recruits from New England colleges.

CHARLES F. BROOKS has received leave of absence from Yale University where he was instructor in geography, in order to become an instructor in meteorology in the Signal Service.

MAJOR GENERAL WILLIAM C. GORGAS, who has now returned from his inspection trip to France, has received from Secretary Baker a letter, which has been made a part of his military record, expressing the appreciation

of the nation for his distinguished services during a long career as a medical officer of the army. General Gorgas, formerly surgeon general, was recalled to the active list when he reached the retirement age while in France. His first task will be to prepare a report on the care of sick and wounded American soldiers in France.

It is planned that scientific information regarding the influenza epidemic now daily accumulating in the New York State Department of Health and elsewhere shall be correlated and made available to health officials and the medical profession through the action of Governor Whitman, who on October 22 appointed a commission to study and report on the cause, prevention and treatment of the disease. Among those who have been invited to serve on this commission are the surgeon generals of the United States Army, Navy and Public Health Service, Dr. Rufus Cole; Dr. Walter B. James, president of the Academy of Medicine, New York City; Dr. Hermann M. Biggs, New York state commissioner of health, and Professor William H. Park, director of the Research Laboratories, New York City Department of Health.

For the purpose of coordinating the policies of the War Department and the Navy Department in patent matters the secretary of war and the secretary of the navy have established the Munitions Patent Board. The membership consists of Thomas Ewing, who has been jointly selected by the secretary of war and the secretary of the navy, Max Thelen, representative of the War Department, and Pickens Neagle, representing the Navy Department.

Dean Albert R. Mann, of the College of Agriculture of Cornell University, has been appointed by Governor Whitman a member of the State Food Commission, filling the vacancy created by the resignation of President Schurman on his departure for Europe. By virtue of this appointment Dean Mann becomes also a representative of the state of New York on the Federal Food Board.

Professor George F. Atkinson, of Cornell University, returned the last of August from a trip through Florida, Georgia, South Carolina, North Carolina and Virginia, in search of fleshy fungi. He left Ithaca on September 13 for the western coast, where he will continue his search, beginning in the mountain forests near Seattle, and going through Washington, Oregon and California. If the season is favorable, he will remain through January and February.

Dr. F. M. Fernandez, editor of the *Cronica Medico-Quirurgica* of Havana, was recently awarded the Cañongo prize by the Academy of Medical, Physical and Natural Sciences for his work on the etiology and treatment of strabismus.

The thirty-sixth stated meeting of the American Ornithologists' Union will be held at the American Museum of Natural History, New York City, November 12–14.

A memorial service for the late Professor Henry Shaler Williams was held at Cornell University on October 19. President Schurman presided and made a brief address. Other speakers were Professor Herbert E. Gregory, of Yale, on Professor Williams at Yale; Professor Herman L. Fairchild, of the University of Rochester, on Professor Williams among geologists, and Professor Edward L. Nichols, of Cornell, on Professor Williams and Sigma Xi. Letters were read from Professor James F. Kemp, of Columbia University, formerly of Cornell, on Professor Williams at Cornell, and from Secretary Charles D. Walcott, of the Smithsonian Institution, on Professor Williams the investigator.

Dr. F. F. Wesbrook, president of the University of British Columbia, previously professor of pathology in the University of Minnesota, died on October 20, at the age of fifty years.

Professor William Leslie Hooper, head of the department of electrical engineering at Tufts College, died at his home in Somerville on October 3. Professor Hooper had been a member of the faculty at Tufts for thirty-five

years and was acting president in 1912 and 1913. He was born at Halifax, N. S., in 1855.

Captain George S. Mathers, for three years a member of the staff of the McCormick Institute for Infectious Diseases, Chicago, died of pneumonia on October 5, in his thirty-first year. At the time of his death Captain Mathers was in charge of the laboratory of the base hospital at Camp Meade.

Professor John Floyd Stevens, instructor in Cornell University from 1908 to 1913, and later assistant professor of electrical engineering in the University of North Dakota, who had recently gone to Schenectady to enter the employ of the General Electric Company died on October 1, of pneumonia.

Stuart C. Vinal, M.S., assistant entomologist, Massachusetts Agricultural Experiment Station, died on September 26 at the age of twenty-three years. He discovered the presence of the European corn borer, *Pyrausta nubilalis*, in this country last year and was engaged in the study of its habits when seized with influenza.

The death is noted in *The Auk* at the age of eighty-four years of Professor Jonathan Young Stanton, who occupied the chair of Greek and Latin in Bates College from 1863 until his retirement as professor emeritus in 1906. Professor Stanton took a deep interest in the study of ornithology. For many years he conducted classes in this subject both in the lecture room and in the field, and after his retirement in 1906 until about a year before his death continued to give lectures and conduct field classes.

The Auk also announces the death of Colonel William Vincent Legge, a corresponding fellow of the American Ornithologists' Union, in Tasmania in his seventy-fifth year. Colonel Legge's chief interests outside of his profession were forestry, physiography and ornithology. He was one of the founders of the Royal Australasian Ornithologists' Union and its first president. During his nine years service in Ceylon he gathered the materials for his most important ornithological work, "The Birds of Ceylon" in two volumes, quarto, with colored plates, which he published during a subsequent staff appointment in England. Among his other ornithological publications is his "Systematic List of Tasmanian Birds."

A bill is under consideration in Congress for an appropriation of $250,000 to build an addition to the Hygiene Laboratory of the Public Health Service in Washington, D. C., and in the house, a special rule has been brought in making this bill a special order.

Owing to the depletion of its staff by the demands of the war and the difficulty of securing a sufficient number of competent assistants with the funds available, it is anticipated that the investigations with the respiration calorimeter which have been in progress at the Pennsylvania State College under the direction of Dr. H. P. Armsby since 1902 with the cooperation of the United States Department of Agriculture will have to be discontinued for the present. The investigations since 1915 have been upon the metabolism of dairy cows, with the cooperation of the Dairy Division of the department, and it is hoped that it may be possible to continue such phases of the work as do not require the use of the calorimeter.

According to a press dispatch from Paris Dr. Alexis Carrel, of the Rockefeller Institute for Medical Research, of New York, was recently seeking a building at Saint Cloud suitable for a laboratory and workshop near certain hospital centers. He found the house he wanted in a park full of splendid trees. The "Verger" (Orchard), as the property was called, belonged to Andre Bernheim, who had refused the most tempting offers to rent it on account of the family souvenirs it contained and the art treasures. When Mr. Bernheim heard of Dr. Carrel's wish to lease his house he said "Tell Dr. Carrel that I am greatly flattered at his choice and that the Verger and its surroundings are at his service." When the question of rent was raised, Mr. Bernheim declared, "No, no, a scientist owes nothing to anybody. It is I who am honored."

Dependent almost wholly upon Germany for potash at the outbreak of the war, the United States within two years will be able to manufacture enough to supply the nation's needs.

Secretary Lane made this announcement in reviewing the progress made by private concerns and the Department of the Interior in developing means or producing potash. In addition to the manufacture of potash from the brine lakes of California, Nebraska and other states, and kelp or seaweed of the Pacific coast and from various minerals, the secretary said that through processes discovered by Dr. Frederick Cottrell, chief metallurgist of the Bureau of Mines, potash is being made from smelter, blast furnace and cement plant by-products. A single large blast furnace, it is estimated, will yield from 5,000 to 7,000 tons of potash annually.

The national park on Mount Desert Island, on the Maine coast, is henceforth to be known as Lafayette National Park. Announcement to that effect has been made by Secretary Lane of the Department of the Interior. The new national park is to embrace lands once owned by France and the name conferred upon it is meant to express America's deep sympathy with France, as well as grateful appreciation of aid afforded to us by that nation in the past. Two years ago these lands were proclaimed the Sieur de Monts National Monument. They constitute the dominant and chief landscape part of Mount Desert Island. The island was discovered by Champlain and for more than a century was a part of French Arcadia.

The Scottish Geographical Magazine states that the Council of the "Touring Club Italiano" has announced its intention of producing a *Grande Atlante Internazionale.* In its general scope and conception the Atlas is to be essentially Italian, but it will also emphasize international features. Italy aims at the extension of her world commerce, and particular attention will be paid to showing the means of communication and transport in different countries. Whilst developing the best characteristics of the great atlases which it desires to emulate, it will also include various large-scale maps of the Italian colonies and those parts of Italy most frequented by tourists. The whole scheme is a considerable undertaking, but it appears to be well organized. The maps are to be issued to subscribers in sets, and each set will be complete in itself for one or more countries. It is expected that about sixteen maps will appear annually, and that it will take about eight or ten years to complete the whole work. This seems a long time, but it is hoped that progress will be expedited when the work is fairly under way. The scientific editor of the atlas is to be Professor Olinto Marinelli of Florence; the technical work of drawing and engraving will be under the supervision of Signor P. Corbellini; whilst the general direction will be controlled by Signor L. V. Bertarelli at the office of the club in Milan. The Touring Club Italiano had done excellent work in the past, and its cartographic achievements in the department of touring maps and guidebooks are worthy of high praise. We have, therefore, every reason to believe that this new and ambitious venture will justify all expectations of success.

UNIVERSITY AND EDUCATIONAL NEWS

Dr. Allan J. Smith has been appointed dean of the medical department of the University of Pennsylvania in succession to Dr. William Pepper.

Dr. E. D. Ball, state entomologist of Wisconsin, has accepted the position of chairman of the department of zoology and entomology at the Iowa State College at Ames. He will also be entomologist of the Experiment Station and state entomologist.

Dr. Joseph Peterson, assistant professor of psychology in the University of Minnesota and chairman of the department for the present academic year, has resigned to accept a professorship in psychology in George Peabody College for Teachers, Nashville, Tenn.

Dr. R. M. Winger, of the department of mathematics of the University of Oregon, has accepted a professorship in mathematics at the University of Washington.

Dr. E. L. Packard, head of the department of geology at the Agricultural College of Mississippi during the past year, has returned to

the University of Oregon as professor of geology.

GEORGE W. MUSGRAVE has resigned his position in the Bureau of Soils, United States Department of Agriculture, to become assistant professor of agronomy at Rutgers College.

DR. R. KUDO, formerly in charge of the department of protozoology of the Imperial Sericultural Experiment Station of Japan, and last year temporary assistant at the Rockefeller Institute in New York City, has been appointed instructor in zoology at the University of Illinois.

MRS. HELEN B. OWENS has been appointed instructor in mathematics at Cornell University.

JOSEPH WARREN PHELAN has been appointed lecturer on industrial chemistry at Harvard University. Harlan True Stetson has been appointed instructor in astronomy in the same institution.

DISCUSSION AND CORRESPONDENCE

THE SCIENTIFIC NAME OF THE PASSENGER PIGEON

THE technical name of the passenger pigeon has for many years been *Ectopistes migratorius* (Linnæus) (= *Columba migratoria* Linnæus, "Syst. Nat.," ed. 12, I., 1766, p. 285). There is, however, another name, *Columba canadensis* Linnæus ("Syst. Nat.," ed. 12, I., 1766, p. 284), based on the *Turtur canadensis* of Brisson ("Ornith.," I., 1760, p. 118), that needs consideration. Reference to Brisson shows conclusively that his detailed description is that of the female passenger pigeon, as he mentions particularly the rufescent tail-spots. Both *Columba canadensis* Linnæus and *Columba migratoria* Linnæus are of equal pertinence, and there seems to be no reason for the rejection of the former, since both the International and the American Onithologists' Union codes of nomenclature provide definitely for the enforcement of the principle of anteriority (page precedence) in such cases. We should, therefore, hereafter call the passenger pigeon *Ectopistes canadensis* (Linnæus).

HARRY C. OBERHOLSER

ALLEGED REDISCOVERY OF THE PASSENGER PIGEON

STATEMENT BY JOHN M. CLARKE, DIRECTOR NEW YORK STATE MUSEUM

The enclosed letter from Mr. M. Rasmussen, of Amsterdam, N. Y., is in reply to an inquiry from me regarding a statement of his discovery which Mr. Rasmussen had left with one of my associates at the State Museum.

I have had a personal interview with Mr. Rasmussen since the date of the enclosed letter, in which he tells me that he has been a student and observer of birds for twenty-five years; that he had with him on this date, October 1, Mr. C. O. Wilson and Mr. William Sanders, of Amsterdam, both students, and that they were together for a bird study trip through the country in the vicinity of West Galway and Charlton, N. Y.

56 GLEN AVE.,
AMSTERDAM, N. Y., October, 5, 1918.

DR. JOHN M. CLARKE,
Director, State Museum,
Albany, N. Y.

Dear Sir: Answering your letter of yesterday: Yes I am absolutely sure that the birds were passenger pigeons and not the mourning dove. I could not have made this positive observation by seeing the flock, because we did not get close enough to make sure, but some were in a buckwheat field on the opposite side of the road from the field where we raised the flock, and because we knew, by seeing the flock and by the whistling sound of their wings, that we had seen wild pigeons we took precaution to get as close to them as possible. Two of us were fortunate enough to have a bird light on a low limb of a tree only a few feet in front of us, as we were standing still under cover in the edge of the woodlet, while my dog was raising the birds in the field. We were so close that we could see the orange-red skin about the eyes, and the bluish color of the back and the head with no black spot near the ear region; also the large size of the bird convinced us that we had a passenger pigeon before us, and that we had seen a small flock of them a few minutes before.

The mourning dove is not so rare a bird to me. I have seen small flocks of them from time to time during the twenty-five years I have lived in this state.

I never but once before saw wild passenger

pigeons and that was near Ithaca, about twenty years ago.

Very truly yours,

S. M. RASMUSSEN

DO WE WANT A GREAT PRIVATE INSTITUTION FOR INVENTORS LIKE THE INSTITUTE OF FRANCE FOR ARTISTS?

I AM impressed doubtfully by a pretentious plan which I have seen for a national laboratory for invention and research. I question seriously if inventors want a great, powerful group of men in existence who can do them just as much injury as good by its hasty condemnation of their so-termed "useless" inventions as by helping them with those which certain men, chiefs of proposed bureaus, may see something in.

Let us not forget that Professor Langley and Mr. Graham Bell who backed him were both ridiculed by the three greatest pioneers of their time, Lord Kelvin, Carnegie and Newcomb. Have times really changed so amazingly since then?

Men working in laboratories like that of the Geophysical and Terrestrial Magnetic Survey are virtually research men, given a free hand and told to go ahead, as I understand it, whereas in this proposed institution the inventor is taken in as a partner so to speak in the institution and runs the danger of having his invention black-balled by some committee of the institution when a difference of opinion arises regarding his work.

We must remember further that the institution would be to inventors what the municipal lodging house is to tramps. The institution would serve in a measure as an asylum to which every man who importunes men of wealth to supply him with funds for use in his own way would be committed. If the amount of money subscribed optimistically by private individuals for the purpose of developing new inventions were concentrated in one institution, such an institution would be a colossal affair. Would not the effect of such an institution be to check the generosity of men of means towards individual inventors and make them refer the inventor to that institution just as they have by the thousand escaped their duty in fostering research by referring the importuning individual to the Rockefeller and the Carnegie Institutions?

The laobratory idea is all right as a place to work in, but let us encourage rather than discourage individual gifts to individual inventors, for no man is big enough not to have a blind side. Let there be a consulting office to which would-be investors in inventions could write and get opinions about inventions, but don't let us shut the door on the inventor by creating the municipal lodging house idea to which those with money will turn in shirking from their duty towards the inventors with whom they come in contact. With conditions as they are, we were getting out the year before the war, I understand, many more inventions than all the other nations in the world combined. Individual willingness to support inventors must be increasing rather than decreasing in America.

When I think of Langley, the Wrights, Curtiss and a host of others, I can not seem to fit them into this plan at all. Is it not true that the Institute of France, which assumed to pass upon the excellence of the work of young artists, turned down the great Rodin's work, and that it was only his supreme genius in sculpture that enabled him to live down the disgrace of its refusal to recognize him, and did he not when they wished later to acknowledge their error, refuse to allow his name to be proposed? There is a similarity between the individualist stimulus which spurs on both the inventor and the artist, and the question might now be raised as to whether a great institute for invention, similar to the Institute of France for artists, should be created, by which "a standard of merit would be placed upon any invention whatever, and its seal of approval would be equivalent to saying whether the invention was good or bad."

I wish to challenge the idea of committee estimation of inventions. There is a danger of no small proportions in it. What body of men can sit and read the volumes of claims of an unending stream of inventors and not become stale, especially if this work continues for years? What is more discouraging than the cold water of a board's decision, even though it

is as we all know who have served on committees, the opinion often of one man concurred in by others too indolent or tired or bored to look into the case thoroughly. How often the most efficient man on the committee is the astute but destructive critic who can see obstacles on every hand so clearly that he can not see the possibilities; who looking down an avenue of trees sees a wall of tree trunks and fails to realize that as you move forward there are wide open spaces between the trees.

It appears to most people a strange fact that army boards so generally turn down new and valuable inventions. General Anson Mills, for example, recounts in his autobiography how his cartridge belt (now universally used in all armies, I understand) "was submitted to every equipment board of the army organized between 1866 and 1879, but so wedded were the authorities to the use of ancestral methods that no board ever made favorable mention of my invention." This is a phenomenon traceable to the environment of committee organization and not to be explained on the ground of what is usually termed boneheadedness, and it is this environment factor which surrounds the proposed institution for invention that appears not to be appreciated by the originators of the scheme.

An institute devoted to a special field of knowledge which hires men to do research along those lines and gives them facilities and supports them is very different from one which covers practically the whole field of human knowledge and proposes to sit in judgment upon the ideas of the poor inventors.

David Fairchild

CIRCULAR FREQUENCY

It would frequently be convenient if there were in common use a name for the letter n which occurs in the equation

$$y = a \cos nt$$

for simple harmonic motion. Mr. Jeans, in his "Theoretical Mechanics," p. 263, calls this n the *frequency* of the motion. This is unfortunate, because the term "frequency" is usually applied to the quantity $n/2\pi$. Professor Lamb, in his "Dynamical Theory of Sound," p. 10, suggests the term *rapidity*. I recall a few years ago seeing some place the term *Kreisfrequenz*, which suggested that we should perhaps have a satisfactory name for this n if we were to call it the *circular frequency* of the motion. This term is longer than *rapidity*, but it has an advantage in that it naturally calls to mind that the n not only is proportional to the frequency of the motion but also represents the angular velocity of an imaginary particle in the reference circle.

Arthur Taber Jones

SCIENTIFIC BOOKS

The Conservation of Food Energy. By Henry Prentiss Armsby. Philadelphia, W. B. Saunders Co. 1918.

This little book of sixty-five pages contains a vast amount of information concerning the relative values of different feeding substances when they are given to farm animals. The method of estimating these values is new. Armsby states "Aside from the milk requirements of the very young animal, it has been demonstrated to be entirely feasible to produce good yields of milk or well fattened carcasses, not only of cattle and sheep but of swine as well, on a ration containing ample roughage to meet the requirements for maintenance, leaving the concentrates to be applied directly to the production of human food." This is a new view point, for T. B. Wood in England[1] believes that meal made from grain is the chief kind of fodder consumed by pigs. Armsby assumes that the maintenance diet of farm animals is at the expense of coarse fodder, grass, hay, straw, etc., and that the development of food value in the animals may be ascribed to the grain ingested. The grains considered are wheat, corn, barley, rye, oats, rice and buckwheat. When these grains are fed under the above conditions, between 15 and 24 per cent. of their energy may be converted into human food in the bodies of cattle and sheep, and between 36 to 61 per cent. when they are fed to pigs and dairy cows.

[1] "The National Food Supply in Peace and War," Cambridge University Press, 1917.

However, when the grains are milled, the resulting flour used as human food and the offals given to cattle and sheep, then between 56 and 81 per cent. of the energy in the grain is recovered as food for human beings, whereas when the same offals are given to pigs and dairy cows between 60 and 85 per cent. of the energy is so recovered. It is evident that food is best conserved for man when edible grains are taken to the miller and the bran is used in meat production. Armsby shows that there is a considerable loss of energy in the food when barley is used in brewing and corn or rye in distilling. If one assumes that alcohol is without food value, then the waste is very large even though the brewers' and distillers' grains are used as fodder for pigs or dairy cows. The details given in the book are of greatest interest to those conversant with the food situation as a whole.

Graham Lusk

THE FLORA OF NORTH DAKOTA

Less than twenty years ago the first catalogue of the vascular plants of North Dakota was published.[1] Now we have a revision of the list in the form of a flora[2] which follows the plan of the well known floras of Colorado and of Washington. The introductory portion (pp. 151–174) contains a review of botanical collections in the state (3 pages), physiography of the state (6 pages), types of vegetation and their distribution (7 pages), and of plant classification with chart showing the evolution and relationship of families. The main portion contains keys to families, genera and species with citations of specimens and notes on habitat. For many species additional notes referring especially to variation of the species and its resemblance to others are given. These form one of the most valuable portions of the work. A glossary and index follow. A report by the same author on the plants of Barnes County is included in the same volume.

The arrangement of families is that of the Bessey system and the nomenclature is said to be in accordance with the Philadelphia code. A conservative stand is taken in regard to species and genera recognized. Synonyms are used freely and the reasons for reduction of segregates are stated in most cases.

Typographical errors seem to be few but one feature of the press work is particularly unfortunate. The generic and specific names in the keys are placed beyond the body of the text at the expense of the margin, especially that of the left hand side of the page. Italics are used for these names and small capitals for the generic headings, otherwise there is no distinction in type.

North Dakota is to be congratulated upon the completion of a work of as high standard as this. The simplicity of the keys, the glossary, introduction and descriptive notes will contribute much to its value to the people of the state. Notes on the flowering period would have been a valuable addition. Botanists will be especially interested on account of the geographical position of the state, situated as it is in territory not entirely covered by either eastern or Rocky Mountain manuals.

The introduction of Clement's flower chart is an excellent feature. Compared with the one in Clement's "Rocky Mountain Flowers" it seems to have been considerably improved by substituting simple symbols for the structural formulæ and especially by adding apetalous families and methods of pollination.

The writer of this review wishes to state that he has in preparation and hopes to publish shortly a paper which will bring together additional records accumulated since the close of Mr. Bergman's work with such other notes as seem worthy of inclusion.

A catalogue[3] of the plants of the state has

[1] Bolley, H. L., and Waldron, L. R., "A Preliminary List of Seed-bearing Plants of North Dakota," Bul. No. 46, N. D. Exp. Station, 1900.

[2] Bergman, Herbert F., "Flora of North Dakota," Sixth Biennial Report, Agr. College Survey of N. D., pp. 151–372, 1911–1912 (pub. September, 1918), The Bismarck *Tribune*, State Printers. The complete report of flora only may be obtained from Herbert A. Hard, Fargo, N. D. Postage 20c. Report in cloth 25c.

[3] Lunell, J., "Enumerantur Plantæ Dakotæ Septentrionalis Vasculares," *Am. Mid. Nat.*, Vol. 4–5, July, 1915–July, 1917 (reprints paged 33 to 188; first 32 blank).

been published recently. In this list citations of specimens are chiefly to the herbarium of the author which has resulted in showing a very limited distribution for a great part of the species. Some descriptive notes are given and occasionally a key to species. Among the latter is one of *Carex* contributed by Mackenzie.

Specific limits are closely drawn and subspecies are numerous. Eight new species and thirty-five subspecies are described. The nomenclature which is based upon absolute priority, is worked out with the assistance of Dr. J. A. Nieuwland, and entails changes in over 230 of the 1,246 names on the list. Fifteen new names are proposed for genera and a considerable synonymy is given.

Changes in names are unpopular with many people and narrow limitation of species yet more. But is not the "splitter" entitled to a certain measure of credit? Not infrequently do some of his discoveries become accepted, even by the conservative. Radical movements have ever resulted in notable advances in some respect. Among cultivated plants we have races of greatly different values which are scarcely separable by the smallest descriptive characters. The describer of new forms has at least brought new facts to attention of others. If variations in plants can be shown to the result of certain conditions, our knowledge has advanced. This seems to be one of the great fields for botanical investigation at the present time.

A first list of fungi[4] of the state has just been completed. This list includes nearly 900 species distributed as follows: Phycomycetes, 22; Ascomycetes, 271; Lower Basidiomycetes, 161; Higher Basidiomycetes, 119; Fungi Imperfecti 119. The completion of this notable contribution is especially fortunate since the author, formerly a physician at Kulm, N. D., is now in the military service. His work is already known through his "Fungi Dakotenses" of which eighteen fascicles of twenty-five numbers each had been issued. In the course of his work many new species have been described, chiefly by Rehm and Saccardo. These are indicated in the list by the designation "n. sp." but no reference is given to place of publication. One new species is described, *Hendersonia Cratægi*.

O. A. Stevens

Agricultural College, N. D.

[4] Brenckle, J. F., "North Dakota Fungi," *Mycologia*, Vol. 9, pp. 275–293, 1917; Vol. 10, pp. 199–221, 1918.

SPECIAL ARTICLES

PEAR BLIGHT WIND BORNE

Waite[1] in 1891 proved that bees were able to transmit the bacteria of pear blight from flowers and in this way spread the disease. Of recent years several important papers have appeared which demonstrate clearly that certain other insects can act as carriers or agents of transfer. The number of insects which have now been convicted is quite large. The list includes *Adelphocoris rapidus* Say,[2] *Aphis avenæ* Fab.,[3] *Aphis pomi* De Geer,[4] *Campylomma verbasci* Mey,[2] *Empoasca mali* Le Baron,[3] *Lygus pratensis* Linn.,[5] *Orthotylus flavosparsus* Sahlberg,[2] *Plagiognathus politus* Uhler,[6] *Pœciloscytus basalis* Reuter,[2] *Scolytus rugulosus* Ratzeburg.[7]

Notwithstanding the fact that it is thus clearly demonstrated that insects can transfer this bacillus, the question yet remains as to how important they actually are in spreading this disease. While they can evidently transfer the disease are they chief or even important agents in its transfer? In order to make tests bearing on this question two pear trees about four meters high were enclosed last year in wooden frames measuring four meters square on the ground and four meters high. These structures were covered with 14-mesh wire mosquito netting. The intention was to

[1] Waite, M. B., report in Smith, Erwin F., "Bacteria in Relation to Plant Diseases," 2: 55.

[2] Stewart, V. B., and Leonard, M. D., *Phytopathology*, 5: 117–123.

[3] Burrill, A. C., *Phytopathology*, 5: 343–347.

[4] Stewart, V. B., N. Y. (Cornell) Agr. Exp. Sta. Bull. 329.

[5] Stewart, V. B., *Phytopathology*, 3: 273–276.

[6] Stewart, V. B., and Leonard, M. D., *Phytopathology*, 6: 152–158.

[7] Jones, D. H., Ontario Agr. College Bull. 176.

determine whether infection was as abundant under such a cover as in the open. Infection was fully as abundant. Conclusions could not be satisfactorily drawn, however, because it was found that the mesh of screen used was large enough under the conditions to allow the entrance of a large number of very small insects. The conditions of the experiment were, therefore, revised this year with the hope of making them crucial. Twelve-mesh wire screen cylinders, 15 cm. in diameter and 30 cm. long, were constructed to enclose parts of single branches. To prevent contact with the branches to be enclosed, cords were run four times transversely through each cylinder. Some of the cylinders were slipped into closely fitting sleeves of fine bolting cloth (124 threads per linear inch). For durability, the bolting cloth was sewed into canvas which formed the ends of the sleeves, covering the rough ends of the wire, and extending past the wire about 14 cm., sufficiently to permit secure tying. The ends of other cylinders were similarly covered with canvas and the exposed part of the wire was painted with a mixture of tangle-foot and benzene. The cylinders were slipped over branches including either last year's terminal shoots or bearing wood. In the former case the cylinders were extended far enough past the ends of the branches to allow for this year's terminal growth. All this was done before any of the blossoms opened, at the beginning of the pink-bud stage. The cylinders treated with tangle-foot were repainted frequently enough to maintain a sticky surface. No insects and no traces of them of any sort were found in any of the cages with one exception.[8]

There were ten cylinders enclosing flowering wood. Flowers in two of these cages blighted, as was shown by their appearance and as was verified by microscopic examination. The blight evidently entered through the calyx. Blossom blight was not abundant this season in this orchard.

Forty cylinders, twenty of the bolting cloth and twenty of the tangle-foot type, were used to include terminal growth. Of this year's shoots four in the bolting cloth cylinders and eight in the tangle-foot cylinders blighted, a total of twelve in forty, or thirty per cent. This was practically the same proportion of blighted terminal shoots as prevailed among the unenclosed shoots, as was shown by a count of a thousand terminal shoots on these and adjacent trees of the same variety and age.

From the above facts it appears that there must have been some agency of dispersal other than insects, and that insects were not even of primary importance as carriers. The only tenable hypothesis is that wind was the chief agent of transmission. Supporting evidence for this conclusion is found in two facts: (1) in the lack of insects in the orchard in sufficient numbers to account for the large amount of twig blight and (2) in the entire absence of insects from exuding cankers, whence they might receive their initial contamination. In three years' close observation at blooming time one of the authors (Ruth) has not observed a single case of insect visitation to exuding cankers. Aphids were entirely absent through the season of floral and twig infection. Leaf-hoppers became evident in rather small numbers only after the period of infection had passed. No other insects were present in sufficient numbers to be considered primary agents.

F. L. Stevens,
W. A. Ruth,
C. S. Spooner
University of Illinois

[8] One cylinder was accidentally allowed to dry. Two insects were found in it. The shoot was not blighted.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, NOVEMBER 8, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE INFLUENZA PNEUMONIA PANDEMIC IN THE AMERICAN ARMY CAMPS DURING SEPTEMBER AND OCTOBER, 1918[1]

THE pandemic of influenza which has been prevalent in Europe and which swept over the United States in the spring of 1918, causing much suffering and disability in industrial plants and loss of training time in American army camps, reappeared with greatly intensified violence in September and October. Within a month of its recognition it had been reported from nearly every quarter of the United States, civil and military.

The army and navy camps suffered severely from the outset. Rarely before in the history of war has infection exhibited a more explosive character or has so large a proportion of troops been infected in camps under conditions of abundant shelter and food and freedom from the strains and anxieties of conflict. The epidemic has been attended by an unusual fatality.

The data and deductions contained in this report are such as are warranted by daily telegrams and other sources of information collected during the course of the pandemic. The final and complete statistics will not be available until after the outbreak is completely over.

During the period September 12–October 18, 1918, inclusive, there were 274,745 cases of influenza reported among the troops in America. During the same period there were 46,286 cases of pneumonia and 14,616 deaths.

The incidence of influenza and pneumonia among all troops in the United States, week by week, from the outbreak to and including October 18, 1918, follows:

[1] Published by permission of the Surgeon General of the U. S. Army.

CASES OF INFLUENZA AND PNEUMONIA AND DEATHS EACH WEEK AMONG ALL TROOPS IN THE UNITED STATES FOR THE PERIOD, SEPTEMBER 12–OCTOBER 18, 1918

	September		October			Total
	20	27	4	11	18	
Influenza ..	10,094	37,493	88,478	90,393	48,287	274,745
Pneumonia.	758	4,313	8,655	17,882	14,768	46,286
Deaths	96	951	2,275	6,005	5,289	14,616

The foregoing table indicates that the pandemic claimed the greatest number of victims in the week ended October 11; this was four weeks after the first local outbreak was discovered. In this week, roughly one third of all the cases of influenza and pneumonia and deaths occurred.

THE OUTBREAK OF THE PANDEMIC

The first report that a serious epidemic existed in any camp came from Devens, at Ayer, Mass. On September 16 the camp sanitary inspector, reporting through the camp surgeon to the Surgeon General of the Army, announced that an epidemic of so-called "Spanish influenza" had broken out at Devens as a part of a general epidemic which had attacked Boston and the neighboring states and towns some weeks before.

The Devens epidemic is supposed to have commenced on September 7, 1918, in D Company, 42d Infantry. On that date a case of supposed meningitis was sent to hospital from this company; on the following day twelve cases were sent for observation. These proved to be influenza. By the sixteenth 37 cases had gone from the same company. One death from pneumonia had occurred. Almost simultaneously, other cases appeared in other organizations. By September 12 the total number of cases which had been admitted was 599. The disease spread rapidly, in spite of the measures taken to check it. On September 20 the epidemic reached its maximum intensity. On that day 1,543 new cases were reported as having been admitted to sick report. After reaching this high point the number of new cases rapidly became less, so that by the end of the month there were less than 100 new cases reported per day.

Meanwhile, pneumonia had become a frequent and fatal accompaniment of the influenza at Devens. Fifty new cases were reported September 19, less than three weeks after the influenza had broken out. The number rapidly increased; on September 24, there were 342 new cases. The number each day remained at about 200 for four days; then there was a decrease, until, before the end of the month, 40 per day had been reached. Since October 4 there have been less than five new cases daily.

The Devens outbreak, so far as may be understood from the records at hand, could be divided into 4 parts as shown in the following table:

THE RISE AND FALL OF THE INFLUENZA-PNEUMONIA EPIDEMIC AT CAMP DEVENS, AYER, MASSACHUSETTS, 1918

	Duration Days	Cases Infl.	Cases Pneu.	Deaths
Rise (Sept. 12–19)	8	3,283	43	16
Peak (Sept. 20–21)	2	2,722	205	43
Rapid decline (Sept. 22–29) ..	8	3,141	1,495	298
Slow decline (Sept. 30–Oct. 18)	19	571	571	310

It will be observed from the foregoing table that the rise of the epidemic covered a period of about 8 days; the peak 2 days; the rapid decline 8 days, and the slow decline 19 days. Half the deaths and nearly three quarters of the pneumonia occurred during the period of rapid decline or within less than three weeks of the outbreak.

CHARACTERISTICS OF THE DEVENS EPIDEMIC

The characteristics of the Devens epidemic have been described here because they represent what has occurred at many camps. The earliest cases have often escaped identification. They may be taken for cases of food poisoning, meningitis, or one of the common exanthemata. The disease which is epidemic bears little resemblance to the coryzas and other respiratory

affections to which the term influenza has been generally applied for the last twenty years.

The leading symptoms in the typical cases are: severe headache; chills or chiliness; pains in the back and legs; temperature sometimes as high as 104; great prostration; drowsiness. Occasionally there are nervous symptoms; sometimes, but not always, the eyes and the air passages of the nose and throat are affected; there may be gastro-intestinal disturbances. The onset is sudden. The patient can often tell the exact moment of his attack. In the typical case he is very sick—wholly incapacitated for exertion. He lies curled up and can hardly be roused for food. In two or three days the fever usually disappears by crisis and the patient feels that he is rapidly recovering. It is highly important that he be well cared for and kept comfortably warm during the next week. Pneumonia occurs in about 18 per cent. of the cases; it proves fatal in over one third of those attacked.

The fact that an epidemic existed in a camp has generally been recognized when the number of new cases has amounted to 100 or more per day. The incidence then increases rapidly. Sometimes the records show a great number of cases at the start, and there are marked fluctuations in the daily incidence as the epidemic continues. Striking irregularities do not represent the way in which the disease occurs but are to be accounted for by the stress and difficulty with which the returns are collected. The greatest number of new cases reported for any day has often considerably exceeded 1,500 in a camp. At Devens the maximum was 1,543. At Grant, 1,810 and Custer, 2,800. The high point has often been reached on about the tenth day of the epidemic.

Epidemics commonly subside almost as rapidly as they arise. Within from 16 to 20 days after the outbreak the number of new cases per day falls to 200 or less, after which there is a more gradual decline to the end. In its epidemic aspect, as in the individual case, the disease is characterized by sudden onset, great intensity, and rapid recovery.

Within about a week after the outbreak of the influenza there occurs an ominous prevalence of pneumonia. The pneumonia does not exist as a separate epidemic, but is always a follower of the influenza. How the two diseases are related is not positively known. It is clear that the influenza paves the way for the pneumonia, if it does not actually produce it. Most of the pneumonia is of the lobular type and presents various unusual aspects. The time of greatest incidence is usually about a week after the greatest incidence of influenza.

SPREAD OF THE PANDEMIC

The second camp to report an epidemic following Devens, was Upton, on Long Island, N. Y.; the third was Lee, in Virginia. Dix, in New Jersey, and Jackson, in South Carolina, followed immediately. Hoboken, N. J., Syracuse, N. Y., Gordon, in Georgia and Humphreys, in Virginia, all reported on the same day. Within a week from the start, nine large camps in widely separated parts of the country were attacked. Others followed in rapid succession. The table on the following page gives the order in which the camps were attacked. In addition there were many epidemics reported from posts, aviation stations and other troop centers.

THE OUTLOOK FOR THE FUTURE

How far the pandemic will spread will apparently depend only upon the material which it can feed upon. It is too early to foretell the end or to measure the damage which will be done before the pandemic disappears. Enough is known to show that hereafter influenza is not to be ranked merely as an endemic disease of civil life, but an infection of first-class military possibilities. It is not improbable that the present pandemic may disappear as rapidly as it came, although most persons hold the opinion that its final disappearance will be gradual, the extinction of the disease being postponed for many months. In the pandemics which sweep over the earth at long intervals, recurring waves of the disease in greater or less degree commonly occur. If this rule holds

Order	Camp	Location	Date
1	Devens	Massachusetts	Sept. 12
2	Upton	New York	" 13
3	Lee	Virginia	" 17
4	Dix	New Jersey	" 18
4	Jackson	South Carolina	" 18
5	Hoboken	New Jersey	" 19
5	Syracuse	New York	" 19
5	Gordon	Georgia	" 19
5	Humphreys	Virginia	" 19
6	Logan	Texas	" 20
6	Funston	Kansas	" 20
6	Meade	Maryland	" 20
7	Grant	Illinois	" 22
7	Taylor	Kentucky	" 22
8	Sevier	South Carolina	" 23
8	Lewis	Washington	" 23
8	Newport News	Virginia	" 23
9	Pike	Arkansas	" 24
10	Beuregard	Louisana	" 25
10	Eustis	Virginia	" 25
11	Greene	North Carolina	" 26
11	McClellan	Alabama	" 26
12	Kearney	California	" 27
12	Bowie	Texas	" 27
13	Johnston	Florida	" 28
13	Sheridan	Alabama	" 28
14	Sherman	Ohio	" 29
14	Dodge	Iowa	" 29
14	Shelby	Mississippi	" 29
15	Custer	Michigan	" 30
16	Travis	Texas	Oct. 1
17	Cody	New Mexico	" 3
18	Forrest	Georgia	" 6
19	MacArthur	Texas	" 7
20	Wadsworth	South Carolina	" 11
20	Wheeler	Georgia	" 11
20	Greenleaf	Georgia	" 11

true now we may look forward to another pandemic before many months are past. It is to be remembered that the present is the second, not the first, great wave which has occurred here this year.

The pandemic now raging may truly be termed an epidemic of epidemics. However desirable it may be to ferret out the cause to the first case this can not be done. Like all great outbreaks of this most infectious of communicable diseases, the epidemics now occurring appear with electric suddenness, and, acting like powerful, uncontrolled currents, produce violent and eccentric effects. The disease never spreads slowly and insidiously. Wherever it occurs its presence is startling. The consternation and alarm which it produces frequently lead to irrational and futile measures to check it.

In theory and practise influenza is preventable but it is very difficult to control under municipal and military conditions. It rarely happens that the necessary measures—chiefly isolation—are taken in time. In the present pandemic the disease has, on more than one occasion, been confined to certain wards of hospitals to the exclusion of others. It is not possible as yet to state to what extent it has been restricted in camps. No large camp has escaped it.

The following table gives the numbers attacked and the deaths recorded up to October 18 in twenty of the largest camps and cantonments:

TABLE OF CASES AND DEATHS AMONG 20 CAMPS GROUPED IN THEIR CHRONOLOGICAL ORDER OF ATTACK

	Total Cases Influenza	Total Cases Pneumonia	Total Deaths Pneumonia	Per Cent. Attacked Influenza	Per Cent. Pneumonia to Influenza	Per Cent. Deaths Pneumonia
Five camps attacked (Sept. 12–18)[2]	45,789	7,671	2,861	20.6	16.7	37.3
Five camps attacked (Sept. 22–24)[3]	42,267	7,399	2,591	21.2	17.3	35.
Five camps attacked (Sept. 29–Oct. 1)[4]	32,932	6,818	2,280	21.8	20.7	33.6
Five camps attacked (Oct. 3–11)[5]	17,307	1,236	210	22.8	7.1	17.8

As the pandemic has progressed the proportion of soldiers attacked has increased, and the proportion developing pneumonia has increased while the fatality of the pneumonia has diminished. These differences have been slight, but they seem to be unmistakable. If these figures are fully substantiated by later

[2] Devens, Upton, Lee, Dix, Jackson.

[3] Grant, Taylor, Sevier, Pike, Newport News.

[4] Sherman, Dodge, Shelby, Custer, Travis.

[5] Cody, Forrest, MacArthur, Wadsworth, Greenleaf.

and more complete returns, the facts and inferences to be drawn from them will be of great moment.

The disease is carried from place to place by persons, not things or by the general atmosphere, as was once supposed. Its rapidity of spread is due to its great infectivity, short period of incubation, missed cases and absence of timely precautionary measures. It would appear that an epidemic does not easily start, but once the flame is well kindled a conflagration occurs which can not be stopped. The epidemics stop themselves. This they do either by the exhaustion of the susceptible material, by a reduction in the virulence of the causative agent, or both.

The causative agent is believed to be the bacillus of Pfeiffer; the means of transfer; the air and objects recently contaminated by the buccal and nasal secretions of those who harbor the virus. It is a fundamental assumption that influenza is produced when, and only when, material from the mouth or nose of infected persons gets into the mouth or nose of someone who is susceptible. As is plainly recognized in respect to intestinal infections, the hand probably plays an important part in the transmission of influenza. Coughing and sneezing help greatly to spread infection.

CHANGES IN VIRULENCE

It has long been known that interchanges of bacteria occur commonly from mouth to mouth under ordinary conditions of social intercourse. Most of the organisms are harmless under normal conditions of health. That their virulence is sometimes increased, sometimes reduced, according to circumstances, appears to be certain. But what the circumstances are which raise or lower the virulence is conjectural. The Pfeiffer bacillus is no stranger to America; it was believed to be present in many healthy persons before the present pandemic. To account for the pandemic it has been suggested that something must have happened to increase its virulence or a new and more active strain has appeared, or the susceptibility of those attacked has become greater.

The conditions which govern susceptibility are not understood. Good general health, absence of fatigue and avoidance of cold and hunger are standard methods of prevention for the individual. Vaccination against pneumonia is practicable but such preventive treatment is in the experimental stage as respects influenza.

The belief that immunity is conferred by an attack is partly confirmed by the observation that in Europe and America a preponderance of persons who have suffered in the present pandemic are relatively young persons, few of whom could have experienced the disease during the pandemic of 1889–90.

The weather has always been supposed to exert an influence upon influenza—the very name is derived from the effect which extraterrestrial conditions were supposed to exert upon it. But although there has been a great deal of study of this subtle matter, little is known concerning it. It seems probable that the weather this fall has aggravated the disease and contributed to the incidence of pneumonia.

The epidemics which occurred in the spring of 1918 were like those which are taking place now, except that the disease was milder and there was less pneumonia. Until recently the influenza reported from Europe was of this mild type. It seems to have been as infectious as it is now. Reports coming from all parts of Europe indicate that the percentage of persons attacked was about the same at that at present.

Something seems to have occurred during the summer greatly to increase the virulence of the disease. During July and August a number of vessels plying between Europe and America experienced intense outbreaks of influenza, accompanied by very fatal pneumonia. That cases of the disease were being brought into the country in this manner was stated in the daily press and in official reports in July.

COMPARISON WITH OTHER PANDEMICS

It is interesting to compare the present pandemic with others, but it is impossible to say

how severe were some of those which are recorded in history for the reason that statistical data concerning them is meager and imperfect. It is said that in 1889–90 no less than 25 per cent. of the population was attacked in London; 33 in Antwerp; 39 in Massachusetts, and in Paris, 50. In 1832–33 about 40 per cent. of the population of Paris is believed to have been affected. In 1872, three quarters of the population of London and some German cities were supposed to have suffered. The records of earlier visitation are more obscure.

Many observers of pandemics in other years have pointed out that influenza is a more fatal disease than is commonly understood, the fatality being due chiefly to lung and heart complications which do not promptly manifest themselves. Thus, although the number of deaths directly attributed to influenza in England and Wales in 1890 was reported as 4,523 per million, the Registrar General, by analysis of the vital statistics for the period, stated that the number of deaths directly or indirectly attributable was 27,074 per million, or nearly seven times the apparent rate. In London the general death rate was increased by over 20 per cent., in Berlin by more than 60 per cent. and in Paris and Brussels by over 100 per cent. No records now available show that there has ever been so much fatal pneumonia as in the present pandemic

The total number of cases of influenza in the present outbreak, inside and outside of the army camps, will never be accurately known. Although it is beyond doubt that the disease which is prevalent in the camps is the same as that which is widely distributed in civil life, it is not to be assumed that all the cases which occur are officially reported or that every case which is supposed to be influenza is really that disease. At this season of year there are always epidemics of colds and other respiratory infections. The weather this year has been particularly favorable to their occurrence. Under the present conditions of public anxiety, it is but natural that all cases of illness which at all resemble influenza should receive that designation. The net result of all the factors which enter into the matter is confusion. The army records have been systematically tabulated and studied from the first. When the pandemic has subsided the information to be derived from these data should be of much permanent value.

George A. Soper

Major, Sanitary Corps, U. S. A.,
October 26, 1918

BRITISH SCIENCE IN INDUSTRY[1]

After years of what appeared to be fruitless discussion of the relations between industry and science and an annual crop of proposals as to the means whereby these relations might be improved, it would seem that a beginning is being made with the garnering of the harvest. We have not altogether perhaps lost our old habit of carrying out the pioneer work in the scientific field and leaving to others the commercial tillage; but the shock of war has modified the attitude of the devotee of pure science to industrial problems, and the manufacturer has had proof that the head of the research worker is not always in the clouds. Both parties are learning to respect each other, and the result is proving a national benefit. Some of the directions in which the gain has been made are revealed in the exhibition organized by the British Science Guild which is now being held at King's College.

INITIAL DIFFICULTIES

It need hardly be stated that the difficulties which stood in the way of the organizers were by no means insignificant. Not only had the sanction of the Ministry of Munitions and the Board of Trade to be obtained, but as the usual charge for space has not been made to exhibitors it has been necessary to meet the cost mainly by voluntary contributions and the fact that the exhibition is in no sense a trade fair where orders may be obtained has limited the display to those who were actuated by a sense of public spirit rather than any hope of pecuniary gain. The scope of the exhibition, which it was desired to make representative of industrial development since the war be-

[1] From the London *Times*.

gan, has also been dwarfed by the circumstance that so large a percentage of our manufacturing activities has been concerned with war work which it would not be expedient to display to public view. There has been a restriction of the exhibits from other causes, of which the pressure on manufacturers for delivery to the fighting services has been the most important. It is a tribute to those responsible for what has been done that in the face of these restrictive influences they have found it possible to secure the cooperation of manufacturers and scientific workers concerned with so many different branches of industry as to make an effective display of articles now produced in home workshops and laboratories which before the war were obtained chiefly from enemy countries. The chemical, electrical and mechanical engineering industries, iron and steel and non-ferrous metals trades, scientific instrument manufacture, the textile glass industries, and aviation and road transport, as well as food production and preservation, and surgery and bacteriology, have all been laid under tribute.

The first impression the visitor gains is perhaps one in which confusion occupies the chief place. For the moment it would almost seem as if a collector had been allowed to run riot through a host of products, the uses of which are often as asunder as the poles. This impression passes, and the exhibition is seen in its right perspective—not as an ordered sequence of manufacturing processes, but as illustrating the latent capacities of some of our scientific industries, the proper development of which has in the past been throttled partly by the stress of subsidized competition, partly by indifference and lack of application of science to the solution of industrial problems. The numerous sections into which the exhibition is divided are so many milestones on the roads of progress that lead in various directions towards the goal of increased national efficiency.

METALLURGY

The section which is devoted to ferrous metallurgy illustrates the character of the task which has been undertaken during the war. It is now a familiar story how the cutting off of supplies from enemy sources of certain materials essential to the steel trade embarrassed this great industry. The supply of refractory materials not only for the constantly expanding steel trade, but for other key industries had somehow to be maintained Accounts have been given in the *Engineering Supplement* of the fine work done in exploiting our own sources of supply of coke-oven and furnace bricks for various requirements, and the exhibits in this class indicate the success which has been won in the organization of a branch of British trade which has hitherto lacked the stimulus of national effort. It is also the case that the increased applications of the electric furnace in steel manufacture make it more than ever necessary to invoke the aid of exact scientific investigation in the evolution of refractories to withstand the higher temperatures which are coming into use.

What has happened in connection with refractory materials has been repeated in the case of tungsten, an essential constituent of many special steels. Engineers are aware with what energy, on the initiative of Sheffield manufacturers, this subject was attacked and British firms put in a position to produce a range of compounds and metallurgical products for which they previously relied on Germany, notwithstanding the fact that there are ample supplies of the necessary raw materials within the confines of the Empire. Reference is made above to the developments in electric furnace practise, and the section of the exhibition devoted to ferrous metallurgy contains various examples of recent advances. A somewhat striking exhibit illustrates new methods of producing sound steel.

LIGHT ALLOYS

The outstanding advance in non-ferrous metallurgy to which witness is borne at King's College has been in the production of light alloys, the principal application of which has been in the construction of aircraft. This has called for an increased output, not

merely of aluminium, the basis of many light alloys, but also of magnesium, which is now being manufactured on a considerable scale in Great Britain. The production of electrolytic zinc, an increase in the output of copper alloys, the introduction of metals in the powdered form, a considerable extension of die-casting methods, and a general marked improvement in technical practise are other directions in which this little exhibition gives ground for satisfaction in the character of our industrial awakening.

AIRCRAFT AND ROAD MOTORS

One section of the exhibition shows what has been done by the alliance of science and industry to secure that supremacy in the air which is essential to success in modern warfare. The principles which govern design, materials of construction, trend of development in aircraft engines, the use of parachutes to enable airmen to make a safe descent from a damaged machine, the utilization of women workers in aircraft factories—all these things are either illustrated or suggested.

Another group of exhibits illustrates what has been done by the Gas Traction Committee to promote the employment of gas in substitution for petroleum products as a source of power for motor vehicles, and a completely fitted road transport vehicle shows the high pressure equipment which has been approved by the committee for the purpose of an experiment on a commercial scale with 20 motor-omnibuses in London service.

ELECTRICAL APPARATUS

In the electrical section the display is a little disappointing, but the progress in this and other departments of manufacture which have called for the assistance of research workers is indicated, where the exhibits fail to show it, by the excellent series of special articles which form the first section of the official catalogue. Two outstanding developments are, however, the subject of exhibits in the electrical group. One of them shows what has been done to establish a British magneto industry, with the result that during the past four years 300,000 magnetos have been manufactured for war service alone. The measure of this achievement is expanded by the claim which can be justly made that the British magneto is as good as that for which German manufacturer previously held a monopoly. The other exhibit illustrates the progress of electric welding.

The display of scientific instruments is also somewhat meagre, but it has been difficult for maunfacturers to withhold deliveries which were in urgent demand, and the exhibition has been robbed to serve the needs of the country. Much progress has, however, been made in original design, and the output during the war to meet the requirements of the Admiralty, the Ministry of Munitions, and the Air Board has been remarkable. The exhibits sent by the National Physical Laboratory indicate some of the lines of advance, a particular example being the mirror extensometer, a type which was formerly made in Germany. The exhibit from the Teddington establishments shows the character of the experimental work which is now being carried on in the gauge rectifying shop with the object of speeding up the manufacturing process and of obtaining an increased degree of accuracy.

CHEMICAL INDUSTRY

If the special work which has been undertaken on behalf of the engineering trades has been selected for attention here, it is not because equally good results have not been obtained in other industries, but because the situation in engineering was essentially typical of that which existed at the outbreak of war. Nothing which has been accomplished during the past four years is of greater importance than the work in connection with chemical products and processes. The grave deficiencies in the supply of the materials for the production of explosives, dyes and drugs, and the lack of trained chemists to supervise manufacturing processes, have been largely overcome, while experimental work in connection with the supply of intermediate prod-

ucts for the production of dyes—hitherto a great German monopoly—has met with very gratifying success. Quite apart from what has been done by the powerful interests represented by British Dyes (Limited) and its allies, specimens are shown by the Chemical Research Laboratory of the University of St. Andrews of twenty-five fine chemicals previously obtained from enemy sources, most of which are now prepared on the manufacturing scale by processes developed in the laboratory during the past three years and a half.

TEXTILES AND GLASS

Mention must also be made of the extraordinary development of the textile industries. As the exhibits sent by the Bradford Technical College and the Nottingham Chamber of Commerce demonstrate, a considerable advance has been made in the production of worsted goods and of cotton embroideries which were previously almost exclusively imported from Germany. It is recognized that the production of knitting needles is one of the key industries necessary to make Great Britain self-supporting, and a great effort has been made to increase the British output of latch needles, in which before the war Germany held 90 per cent. of the world's trade. Nor is it inappropriate, in view of the use of King's College for the exhibition, to refer to the work which has been done by Sir Herbert Jackson, the professor of chemistry in the college, to provide the chemical and optical glass urgently needed when supplies from Germany and Austria were cut off. The pure potash required for certain glasses is now obtained by a new electrolytic process, and the net result of this and much other work has been the reawakening of the glass industry and the attainment of a position which it is believed is strong enough to enable our manufacturers to meet all assaults upon them.

DOCTOR ALEŠ HRDLIČKA AND THE VERO MAN

In Bulletin No. 66 of the Bureau of American Ethnology there has recently appeared Dr. Aleš Hrdlička's long-awaited report on the human remains found at Vero, Florida. The delay in printing this document has resulted in giving to it some of the flavor of ancient history. In compensation, however, there are introduced certain original ideas in dynamic geology, some of which will be considered below. Unfortunately there is no adequate treatment of that 160-foot geological section which, we were assured,[1] afforded a view at once comprehensive and enlightening.

The writer does not intend to debate the question whether the geologists and the paleontologists ought to have anything to say in such an important matter as that presented at Vero. It is preferred to introduce two expressions of opinion that ought to have a degree of weight. It happens that both of these were called forth by discoveries made some years ago at Trenton, N. J. Professor W. H. Holmes[2] wrote:

> Little by little the advocates of a paleolithic culture in America have been forced to give up the idea that there is any other reliable test of the age of a culture than that furnished by geology.

Dr. Aleš Hrdlička[3] was engaged in studying a fragment of a human femur and a piece of parietal. Not having gained any results from the comparison with corresponding bones from Florida and Mexico, having regard especially to their chalkiness and their tints of yellow, he delivered the following opinion:

> The determination of the age of the two bones, however, must be based principally on their location with regard to geological formation.

It is evident that Dr. Hrdlička has changed his opinion since that sentence was penned. Perhaps the geological test has not always resulted to his liking, and he has resolved to base his judgments hereafter on the state of development of the skeleton, as determined by European standards. Now he tells us[4] that the age of the strata and the determination and age of the animal remains in them are matters quite irrelevant to the discussion of

[1] "Symposium," p. 43.
[2] Science, Vol. XX., 1892, p. 297.
[3] "Papers Peabody Mus.," Vol. V., p. 247.
[4] Bull. 66, p. 60.

the human bones. Anthropology then, so far as it is represented by Dr. Hrdlička, has issued its declaration of independence. We are now informed that the presence of human bones in a deposit can, without the aid of the geologist and paleontologist, be readily explained so long as the deposits could have been penetrated a few hundred years ago by a man who wanted to bury his dead. Any disturbance of the earth would subsequently soon be obliterated by "adventitious stratification" (p. 49, pl. vii). Had our physical anthropologist reached this belated result while he was studying the Trenton bones he need not have so strongly committed himself to the potency of geology.

The case needs further consideration. Mr. Volk[5] had found the above-mentioned fragment of femur at a depth of 7 feet 6 inches. At the surface were 7 inches of black soil, followed below by 16 to 20 inches of yellowish sand, this by 44 inches of coarse gravel and cobble stones, below which were 21 inches of greenish sand. In the latter lay the bone in question. Some obsessed persons have believed that this discovery proved the presence of man in that region during the Wisconsin glacial stage. How much more reasonable it would be to suppose that a modern Indian, with an antler and his endowment of patience (66, p. 43), dug down through those gravels and sands and buried a corpse there? Naturally by the time the black soil, and the yellow and greenish sands, and the gravel and stones had been returned to the grave they would have been pretty thoroughly mixed together; but anybody by examining Volk's figure can see how nicely the materials had rearranged themselves. Had the bone not been discovered, nobody would ever have suspected that a grave had been dug there. The fact that only a piece of bone was found need not cause any surprise or skepticism; for doubtless "dissociation and fragmentation occurred later owing to movements, stresses, root action, and other agencies operating on or within the deposits enclosing the body" (66, p. 48). Apparently the fragment of parietal was caught in its migrations 20 feet away. Perhaps we get a clue here to the reason why civilized peoples nail up their dead in good strong boxes.

That there may occur movements in rocks and soils is well known. There is recognized even a creep of the continents towards the sea. Science has, however, concerned itself too little with the local movements that, according to our author, may go on in a deposit which is not absolutely solid. Some idea of the extent and complexity of these movements may be secured by studying Dr. Sellard's figure[6] which shows the positions of some of the bones of the scattered skeleton found at Vero. Joining by straight lines the parts of a bone or two bones which normally were in contact with each other, one may see the directions along which the forces may, in their simplest expression, have acted and the results thereof. These lines sometimes make nearly right angles with each other. If the suggested movements really occurred in the sand and muck they were probably still more complex. There must have been something like peristaltic action going on there. One can only wonder that the bones subjected to such translations are now found with the edges of fractures unworn and the surfaces unabraded.

One of the surprising results reached by Dr. Hrdlička is that derived from the study of the skull. He now expresses a good deal of doubt about the kind of Indian that owned the skull, if Indian it was at all. We are told, (66, p. 55), that it might be that of an Algonquian, or a Sioux, or even a cross between an Indian and a white man. On the page cited this last impression had been "definitely removed"; but subsequently (p. 59) we are informed that "there remains some persistent doubt" whether the skull was not that of a white-Indian individual. As the case stands now, we may be permitted to believe that the individual was none of these three varieties, but a plain Pleistocene Indian. Perhaps a renewed and intensive study of the pottery and the flint and bone articles might yield a similar result.

[5] "Papers Peabody Mus.," Vol. V., pp. 113–117, pls. 103–107, text fig. 23.

[6] *Jour. Geol.*, Vol. XXV., p. 12, fig. 4.

The distinguished author whose work is being reviewed has great difficulty (66, pp. 42, 43) in understanding how a human skeleton might have become covered up in a deposit being laid down slowly in water; and he concludes thereupon that the body must have been intentionally buried. In the sand deposit no. 2, Dr. Sellards[7] found a nearly complete skeleton of a large alligator. If now, in Hrdlička's remarks "alligator" be substituted for "human body" and "corpse" we shall be compelled to conclude that the alligator too was a subject of intentional burial.

Various other difficulties are encountered by our author regarding the degrees of aggregation and dispersal of the human bones and their physical and chemical states; but after all has been said, the fact remains that they are in practically the same condition as those of the deer and the great armadillo and the alligator, about which nobody raises any questions.

On his page 37 Dr. Hrdlička undertakes a consideration of the "broader aspects of the case" and he asks whether it was possible for man to be in Florida in Pleistocene times. He himself replies that the presence of man there at that time, or even on the American continent, can not be admitted by anthropology. In doing so, he simply assumes that what is supposed to be known about man in Europe furnishes a standard by which all matters anthropological the world over must be settled. He says that no pottery is known to have existed in the world before the Neolithic age. On the contrary, it has been shown[8] that pottery has been found in this country in the early Pleistocene at Charleston, Vero and Nampa. Did an Indian go out furtively into that swamp at Charleston, dig down 8 feet in the muck, and hide away from his fellows, alongside of the mastodon tusk and horse teeth, that potsherd?

On his page 38 Dr. Hrdlička tells us that if man had reached Florida in the early Pleistocene he must have been represented on our continent by large numbers and that these would have left some traces of their presence, of which he insists there are none. On the contrary, the present writer, as cited above, has shown that there are numerous evidences of man's early presence in America. What Dr. Hrdlička seems really to believe is that men at that time were extremely scarce, so few in number that they could not have reached America. At any rate (66, pp. 36, 49, 50) he thinks that the discovery of a single human skeleton at any place would be a marvel; while the chance of finding another near by and in a different geological formation would be infinitely small. This conception is worthy of application to other cases. Some years ago Mr. J. W. Gidley discovered in a crevice in western Maryland, a jaw of an eland hardly distinguishable from the eland of South Africa. How, now, did that eland jaw get into that fissure, "in a little wild spot of the far-away wide inhospitable" mountains of western Maryland? A great part of the Pleistocene must have been required by the ancestors of this antelope for their "physical differentiation, multiplication in numbers, acclimatization to new environments and spread over the numerous territories of the old world, the warmer parts of which were their cradle" (p. 37). And then they had to occupy the new world as far east and south as Maryland! To do this they must have existed in great numbers; and so they might be expected to have left abundant traces of themselves. No such traces have, however, ever been reported from any other locality. The animals must, therefore, have been scarce indeed. What a marvel it is then that remains of one skeleton should have been met with, especially of a species which probably was not addicted to hiding in crevices; but the miraculous thing is that Gidley found in that same formation, in that same fissure, remains of two individuals! This is more astonishing than would be the finding of a second skeleton near by in an overlying formation; for as the years by thousands passed by the chances would increase that parts of another skeleton would be buried not far away. Our credulity is overpowered. Out with geology and paleontology! How

[7] Eighth Ann. Rep. Fla. Geol. Surv., p. 145.

[8] Hay, *Amer. Anthrop.*, Vol. XX., pp. 15, 16, 25.

much easier, how much more reasonable, it is to suppose that a pair of African elands escaped from some passing show, perhaps from one of P. T. Barnum's incomparable aggregations, and fleeing to that mountain side, perished in that fissure! However, the cold fact is that neither our talented physical anthropologist nor any other man knows any more about the number of men in any country during the Pleistocene than he does about the number of Pleistocene elands in North America or the number of chimpanzees that were living in Europe with the Piltdown man.

The writer wishes to correct two misstatements. In SCIENCE of April 12, 1918, on page 371 the statement is made that certain fossils had been found at Wilmington, N. C. Brunswick, Ga., was meant. In the paper in the *American Anthropologist,* Vol. XX., p. 20, it was stated that Dr. Samuel Aughey furnished no details regarding the finding of an arrowhead near Sioux City, Iowa. Details were furnished and the arrowhead was figured.

OLIVER P. HAY

WASHINGTON, D. C.,
October 11, 1918

SCIENTIFIC EVENTS

RECENT ACQUISITIONS FOR THE LIBRARY AND MAP COLLECTION OF THE ROYAL GEOGRAPHIC SOCIETY

THE *Geographical Journal* reports that the liberality of Mr. Yates Thompson has once more brought some interesting additions to the society's collections. One is an illuminated chart, on parchment, of the coasts of the Mediterranean and western Europe, by a member of the well-known family of Oliva (originally Olives), who migrated from Majorca to Italy and worked as chart-makers during the greater part of the sixteen and seventeenth centuries. Their charts were the lineal successors of the old Portolan charts which so long served the practical needs of seamen, and which continued to be made, long after printed maps and charts had come into general use, as an ornate furniture for the libraries of the wealthy. The present specimen is in excellent condition, and bears the inscription "Placitus Caloirus et Oliva fecit in nobili urbe Messane, año 1617." It is remarkable for the *duplication,* with but slight variation, of the portion concerned with the Mediterranean coasts, while the Atlantic coasts are shown independently, though with no dividing line, at the left-hand side of the chart. Another interesting gift from the same donor is that of copies, dated 1556 and 1558, of the map of the British Isles, engraved in Italy after the original by George Lily, whose monogram appears on the earliest known specimen, of 1546, preserved in the British Museum. This map was the first printed map of the islands to give a fairly correct representation of the outline of Scotland, though the means by which such an approximation was attained is unknown. It was revised at various dates, and included in Lafreri's famous Atlas. The two versions now presented are almost exactly alike in substance, but the later of the two was entirely re-engraved on a somewhat larger scale, with slightly more ornamentation, and intended to be read with the west, not the north, at the top. In view of the question sometimes raised whether the name "Britain" includes Ireland, it may be noted that in these maps it is distinctly reserved for the larger island only. Other acquisitions have been made at book sales, of which several during the summer were specially important from the point of view of geography. The seventh portion of the great Huth Library was disposed of early in July, and various early works of travel and geography fetched unusually high prices, justified, no doubt, by the exceptional condition of the copies offered. The society secured through Mr. H. N. Stevens, a copy of the rare small quarto Atlas of America by the French cartographer Nicholas Sanson. It is one of four similar volumes devoted to the four larger continents, of which the library already possessed those on Europe and Africa. These volumes consisted of both maps and descriptive text, and were among the earlier productions of their author, anticipating by some years the larger general atlases by which he is best known. Each ran

through several editions, the American volume first appearing in 1556, and being revised in 1657, 1662 and 1667 (?). The copy has a title-page dated 1662, but the maps all bear the date 1657. It may be noted that the volume contains an early mention, in the chapter on Paraguay, of the great Guayra falls on the Paraná river. Copies have also been secured of the first English edition (1708) of François Leguat's "New Voyage to the East Indies," containing a detailed account of his experiences in the islands of Rodriguez and Mauritius, with descriptions and quaint cuts of their remarkable fauna and flora; and of Le Huen's adaptation (with additions describing his own experiences) of Breydenbach's famous "Perigrinationes in Terram Sanctam." This copy is of the third edition, 1522. Lastly, a complete set has been acquired of the great French "Description de l'Egypte," based upon the work of the French scientific men sent to Egypt by Bonaparte at the time of his intervention in that country.

QUICKSILVER DEPOSITS IN THE PHOENIX MOUNTAINS, ARIZ.

The present exceptional demand for quicksilver in the manufacture of fulminate gives the domestic deposits of this war metal particular interest. Deposits recently discovered in the southern part of the Phœnix Mountains, 10 miles northeast of Phœnix, Ariz., are described in a short paper prepared by F. C. Schrader, just published by the United States Geological Survey. The deposits are easy of access, and being near the rich agricultural region of Salt river valley are otherwise favorably situated for mining. They are being exploited on six or more properties or groups of claims, which lie in a belt, about 3 miles wide, that extends northeastward diagonally across the range.

The rocks in the region are metamorphosed sediments of pre-Cambrian age, chiefly schist, slate argillite, limestone and quartzite. They crop out in narrow parallel zones and dip steeply to the southeast. They are horizontally sheeted and are crosscut by faults, fractures and cleavage. The deposits are in the zones of schist, notably quartz schist and kyanite schist. They are lodelike deposits, some more than a mile long and in places 80 feet wide, which occur along zones of shearing or fracture that are parallel with the lamination of the schists.

The ore minerals are cinnabar and cinnabarite. They are found mostly along the planes of schistosity, forming ore bodies several inches wide and 3 or 4 feet long, but they also occur sporadically in quartz stringers and veinlets. A little native quicksilver has also been reported. Associated with the deposits are copper minerals, especially malachite, chalcicite, and chalcopyrite. The gangue minerals, the chief constituents of the stringers and veinlets, are quartz, calcite hematite, limonite, specularite, kyanite and tourmaline.

The deposits were probably formed by heated solutions or vapors which, ascending through the shear zones, penetrated the interstices of the rocks and deposited their mineral burden as veinlets and films by impregnation and replacement. They are provisionally referred to the Tertiary period, during which volcanism was general in the southwest. Tertiary volcanic rocks occur at several places in the surrounding region.

Although the deposits are but slightly developed, the deepest shaft being but 60 feet in depth, three of the properties yield workable ore that carries 3 per cent. or more of quicksilver. The persistence of the lodes and downward improvement of the ore in the shafts indicate that the ore extends to considerable depths, especially in the oxidized zone.

As the deposits are easily accessible, ore averaging as low as 1 per cent. in quicksilver can no doubt be profitably worked with the metal at its present market price. On one of the properties a retort furnace has been installed and a small amount of commercial quicksilver produced.

The paper describing the deposits, which is published as Bulletin 690-D, under the title "Quicksilver deposits of the Phœnix Mountains," may be obtained by applying to the

Director of the United States Geological Survey.

THE SELECTION OF PRESIDENTS OF THE AMERICAN CHEMICAL SOCIETY

The following report of the committee on election of President, and changes in the constitution, were unanimously adopted at the recent meeting of the American Chemical Society:

The committee appointed to consider a possible revision of the current procedure of the election of a president of the society begs leave to make the following report:

Your committee is of the opinion:

(*a*) That there is need for an increased interest on the part of the membership at large in the selection of presidents of the society, and (*b*) that there should be some procedure adopted which will ensure the presentation of four nominees to the electing body as provided for in the constitution.

After correspondence, consultation and discussion, the majority of your committee makes the following recommendations which they believe will greatly improve the situation, and which, they also believe, can be given a trial without involving changes in the constitution, which are undesirable in these times of stress, notably because of the clerical labor which they require.

These recommendations are:

(1) That the secretary be empowered to request each local section of the society to submit to him, not later than October 15, the name of some person from the membership at large of the society whom they consider suitable for nomination for the office of president of the society. It should be made clear that the selection is to be made from the entire society, and not necessarily from the membership of the Section making the suggestion.

(2) That the Secretary be empowered to send out, with the nominating ballots sent to the members of the society on November 1, as required by the constitution, the names thus suggested by the local sections, the list to be alphabetical and without indication of the section or sections from which any name may have been submitted. This list should be accompanied by a statement indicating that other nominations by individual members are in order, and that the list is suggestive only.

(3) That the secretary be requested to ascertain by telegraph from each member whose name is thus suggested by the local sections, and before the list is sent out, whether, in the event of nomination by the members at large, he will allow his name to be presented to the council as a nominee for the office of president.

(4) That the subsequent procedure be the same as at present.

Two members of your committee (Major Frankforter and Dr. Richardson) dissent from the foregoing recommendations. They favor a return to a procedure abandoned some years ago, under which nominations would be made by the council and submitted to the entire membership of the society for election. The majority of your committee has carefully considered this proposal, but is of the opinion that it is not advisable to revert to the older custom. They favor a trial of the procedure as outlined above before making changes in the constitution. They are of the opinion that this procedure will serve to increase the interest of members in the election of a president, and that it will prove satisfactory. It can be put into immediate operation and avoid constitutional changes at a time when they present unusual difficulties.

Your committee has reviewed the constitution and, while there are some clauses which might be modified in wording to some advantage, there appear to the majority of your committee to be no matters of serious import at this time. They recommend that no alterations be made at present.

Respectfully submitted,

H. P. Talbot,
M. T. Bogert,
by H. P. T.
B. F. Lovelace,
by H. P. T.

MEDICAL COMMISSION TO ECUADOR

To prepare for after-the-war commerce and make possible, by prevention of diseases such as yellow fever, a great expansion of trade between the United States and the west coast of South America, the Rockefeller Foundation sent, last summer, a commission to Ecuador. The three American members of this commission, which returned to Chicago early in October, are members of the medical school faculty of Northwestern University, Chicago, Illinois, Dean Arthur I. Kendall, who is a director of the Rockefeller Foundation for experimental work; Professor Charles A. Elliott, and Professor H. E. Redenbaugh. Dean Kendall for two years served under General Wm. C. Gorgas during the construction of the Panama Canal.

The commission left the United States in July and spent most of the time investigating conditions in the hospitals, pest houses and laboratories of the city of Guayaquil, which is the capital and principal city of Ecuador. Latin American papers received here from Guayaquil and other places show that a warm welcome was accorded the investigators who, in their words, were "putting into practise scientific methods for the purpose of invevstigating the parasite responsible for the yellow fever." The South Americans were also pleased with the prospect that the work of the commission in allaying this disease would prepare the way for the opening of commerce on a larger scale with the United States. At present, there is in preparation a complete report with recommendations of the commission. This will soon be issued by the Rockefeller Foundation and should prove of special interest, not only to scientific men, but to business men and others who are looking to after-the-war commercial expansion.

SCIENTIFIC NOTES AND NEWS

The autumn meeting of the National Academy of Sciences will be held in Baltimore on Monday and Tuesday, November 18 and 19, 1918, at the Johns Hopkins University, Homewood. Scientific sessions will be held on both days. Luncheons will be served at the Johns Hopkins Club, where the meetings will also be held. The academy dinner will take place at the Maryland Club on Monday evening.

On account of the epidemic of influenza the public meetings of the American Ornithologists' Union which were to have been held in New York, November 12 to 14, will be omitted. The regular meeting of the fellows and members for the election of officers and the transaction of other business will be held on Monday evening, November 11, at 8 P.M. at the American Museum of Natural History.

Lieutenant Colonel W. C. Spruance has been placed in charge of chemicals in the Ordnance Department.

Professor H. A. Kenyon, of the college of engineering of the University of Michigan, was commissioned as captain during the month of August, and assigned to the executive division of the general staff.

Dr. Frank T. F. Stephenson, past president of the Detroit Section of the American Chemical Society, has been commissioned captain in the Medical Corps.

Professor I. W. Bailey, of the Bussey Institute for Research in Applied Biology, has been given leave of absence by Harvard University and has accepted a position in the materials engineering department, Bureau of Aircraft Production, Dayton, Ohio.

Professor W. R. Dodson, dean of the college of agriculture and director of experiment stations of the Louisiana State University, is working with the Food Administration in the division of agricultural relations.

Francis D. Farrell, dean in the Kansas State Agricultural College, has been appointed by Governor Arthur Capper to membership in the Kansas council of defense. Dean Farrell has also been made a member of the committee on agricultural production of this body.

Mr. Philip G. Wrightsman, formerly instructor in chemistry at Iowa State College, is now in the Chemical Warfare Service working on toxic gases in the Research Division, American University, Washington, D. C.

Dr. Robert S. McEwen, on leave of absence from the department of zoology in Oberlin College is in government service at the Army Medical School at Washington, as instructor in parasitology.

Professor M. F. Coolbough, of the department of chemistry, Colorado School of Mines, is in Washington on leave of absence and is engaged in war work at the Bureau of Mines.

Dr. H. M. Loomis, formerly of the Bureau of Chemistry, Department of Agriculture, has been made chief inspector of the sardine canneries of Maine and Massachusetts, for the Food Administration.

Mr. H. M. Freeburn has resigned as assistant engineer of the Pennsylvania State Department of Health to become associate with the engineering staff of Wallace and Tiernan Co., New York City, manufacturers of chlorine control apparatus and sanitary engineering specialties.

Professor R. E. Caldwell has left his work as chief of the department of dairy husbandry at Purdue University, Lafayette, Indiana, to take charge of the research and educational department recently organized by the Blatchford Calf Meal Company of Waukegan, Illinois. His work will consist mainly in the conducting of feeding experiments in an effort to discover the ingredients necessary to produce the best milk substitute feed for immature animals.

The last number of the *Journal of Industrial Chemistry* among its personal notes records the following changes from educational to industrial work: Professor Benton Dales, formerly head of the chemistry department of the University of Nebraska, research chemist for the B. F. Goodrich Co., Akron, Ohio; Mr. F. W. Bruckmiller, formerly assistant professor of chemistry at the University of Kansas, chemist for the Standard Oil Co. (Indiana), at Sugar Creek Mo.; Professor J. B. Rather, head of the department of agricultural chemistry in the University of Arkansas, chemist with the Standard Oil Company, New York; Dr. M. L. Crossley, acting head of the department of chemistry at Wesleyan University, chief chemist for the Calco Chemical Co., Bound Brook, N. J.; Miss Jessie E. Minor, associate professor of chemistry at Goucher College, chief chemist for the Hammerschlag Paper Mills, Garfield, N. J.; Mr. Carleton B. Edwards, head of the chemistry department at Guilford College, chemical engineer in smokeless powder with E. I. de Pont de Nemours and Co. Similar changes are reported in Science almost every week. It would be in the interest of higher education to record the salaries received in the educational and in the industrial positions, and the time and facilities allowed for research work.

"Chemistry and the war" was the subject of an illustrated lecture delivered to the students at Lafayette College on October 23 by Colonel Wilder D. Bancroft, professor of physical chemistry at Cornell University, now of the Chemical Gas Warfare Service.

The Ingleby Lectures for 1918 before the University of Birmingham were given by Dr. Peter Thompson, professor of anatomy in the university, on October 17 and 24. The subject was "Some problems in embryology."

The Geographical Association has founded a memorial lectureship in memory of the late Professor Herbertson, and M. Schrader delivered the first lecture in Oxford on November 5. M. Schrader is well known by his *Atlas de géographie historique*, and his continuation of the *Atlas universelle* of Vivien de S. Martin, and for his more recent work in the re-afforestation of French mountain slopes.

The Prince of Wales has accepted the position of patron of the Ramsay Memorial Fund, founded in November, 1916, to raise £100,000 as a memorial to the late Sir William Ramsay. The committee has already raised £37,000, and subscriptions from oversea committees will probably bring the total to £50,000. It is proposed to raise the remaining £50,000 by a million shilling fund, now opened with a donation of 1,000 shillings from the Prince of Wales. Already over 10,500 shillings have been privately subscribed. The fund will provide Ramsay Research Fellowships and a Ramsay Me-

morial Laboratory of Engineering Chemistry in connection with University College, London. Donations from one shilling upwards should be sent to the honorable treasurer, Lord Glenconner, at University College, London, W.C.1.

THE faculty of the medical school of the University of Minnesota, Minneapolis, has adopted a memorial to its former dean, Frank Fairchild Wesbrook, M.A., C.N., M.D., president of the University of British Columbia, bearing testimony to his qualities as a scientific man, as a leader and administrative officer, and as a councillor and friend.

LIEUTENANT ADMONT HALSEY CLARK, M. C., U. S. Army, assistant professor of pathology in Johns Hopkins University; resident pathologist to Johns Hopkins Hospital; who had done brilliant experimental work in pneumonia and diabetes, died in Johns Hopkins Hospital on October 13, from pneumonia, following influenza, aged thirty years.

MAJOR ALFRED REGINALD ALLEN, instructor in neurology in the University of Pennsylvania, has been killed in France, aged forty-two years. Major Allen was a leading neurologist but preferred to enter active infantry service.

LIEUTENANT GILBERT DOOLITTLE, U. S. Engineers, son of Dr. Charles L. Doolittle, professor emeritus of astronomy in the University of Pennsylvania, was killed in action on September 25, aged forty-five years.

CHARLES S. CAVERLY, M.D., professor of hygiene in the University of Vermont College of Medicine, and president of the State board of Health since 1891, died, on October 16, in Rutland, Vt., Dr. Caverly was widely known as a specialist in infantile paralysis.

DR. ERNEST G. GENOUD, a specialist on fermentation processes and a member of the staff of A. D. Little, Inc., died at his home in Dorchester, Mass., on October 12, of pneumonia following influenza, aged thirty-eight years.

WILLARD E. CASE, known for his contributions to electrical science, died at Auburn, N. Y., on October 30, of Spanish influenza, at the age of sixty-one years.

WILLIAM MAIN, formerly professor of chemistry in the University of South Carolina and one of the pioneers of the electrical industry, died at his home in Piermont, N. Y., on October 18, in his seventy-fourth year.

HOWARD SHELDON COE, agronomist in the United States Department of Agriculture, died from pneumonia following influenza at Beaumont, Texas, early on the morning of October 25, while absent from Washington on a field trip. Mr. Coe was born at Orrville, Ohio, in 1888, and graduated from the Iowa State College of Agriculture, in which institution he was for a time assistant instructor of botany. In 1913 he was appointed consulting botanist and plant pathologist at the South Dakota Agricultural Experiment Station, which position he held until he entered the service of the United States Department of Agriculture, in July, 1914. He was the author of numerous botanical and agricultural papers.

DR. WILLIAM G. MALLORY, associate professor of physics, in Oberlin College, died of pneumonia on October 19. He received the degree of A.B., from Oberlin in 1905, followed by the master's degree two years later. During this time he was serving as a laboratory assistant. From 1907 to 1909 he was instructor in physics at Oberlin. Then followed a year of study at Cornell University, after which he accepted the professorship of physics and astronomy at Randolph-Macon College. During the winter of 1912–13 Dr. Mallory was a fellow in physics at the University of Chicago, and the next year became acting head of the physics department at Miami University. In 1914 he was called to Cornell as instructor in physics, holding this position until spring of the present year. He received the degree of doctor of philosophy from Cornell in June, 1918, and was chosen to aid in the Carnegie Research work at Ithaca. He went to Oberlin in September, taking the work of Dr. Samuel R. Williams, head of the Oberlin de-

partment of physics, who is at present engaged in war work for the Council of National Defense.

Brigadier-General Edgar William Cox, head of the Intelligence Staff of the British Army in France, was accidentally drowned on August 26, aged thirty-six years. His advancement in the army had been rapid. To scientific men he was known for topographical surveys and publications.

Sixteen platinum dishes and crucibles were stolen from the Kentucky Agricultural Experiment Station, Lexington, Kentucky, during the week following October 17. The police department of Lexington offers $100 for their recovery or for information leading to the conviction of the thief. The urgent need for this material at this time deserves earnest effort and cooperation in its recovery.

The Field Museum of Natural History in Grant Park, Chicago, which is nearing completion, and has cost $7,000,000, has been turned over to the government for use as a hospital. The interior will be rearranged so that 4,300 patients can be accommodated and a number of smaller buildings will be erected around the main structure for the accommodation of 1,000 nurses. The museum building covers six acres and has more than twenty-five acres floor space.

Over 30,000 persons paid for admission to the British Scientific Products Exhibition at King's College. Professor R. A. Gregory, chairman of the organizing committee, states that it is proposed to arrange for an annual exhibition of British science and invention.

Alfred I. du Pont, the owner of the Grand Central Palace, N. Y., has announced that, notwithstanding the fact that the government is to take over the building for the period of the war as a base hospital for the Army and Navy, he intends to proceed with his plans for creating there a center for world commerce after the war in an Allied Industries Corporation.

The Sibley Journal of Engineering, published at Cornell University, announces that with the November issue it will cease to appear until the resumption of normal university conditions.

We learn from *The Auk* that at the annual meeting of the British Ornithologists' Union, Dr. W. Eagle Clarke was elected president to succeed Colonel R. Wardlaw Ramsey who had served for the last five years. The membership of the Union stands as follows: Ordinary 423, Extraordinary 1, Honorary 8, Honorary Lady (the only lady members) 8, Colonial 9 and Foreign 19. The Honorary and Foreign (equivalent to the Corresponding Class of the A. O. U.) it will be noticed are much more restricted than in the A. O. U. The American ornithologists represented in these classes are as follows: Honorary, Dr. J. A. Allen, Dr. Frank M. Chapman, Dr. Harry C. Oberholser, Dr. Chas. W. Richmond and Mr. Robert Ridgway. Foreign, Dr. Leonhard Stejneger and Dr. Witmer Stone.

UNIVERSITY AND EDUCATIONAL NEWS

Additions to the teaching staff of the college of medicine, University of Cincinnati, are Professor Dennis E. Jackson, of Washington University, Professor Albert Prescott Mathews, of the University of Chicago, and Dr. Shiro Tashiro, of the University of Chicago. They have been appointed, respectively, to the chairs of pharmacology, biochemistry and physiological chemistry.

Dean Mortimer E. Cooley, of the department of engineering of the University of Michigan, has been made regional director in the Student Army Training Corps for the district comprising Wisconsin, Michigan and Indiana.

Professor J. W. Young, of Dartmouth College, has accepted the position of director of the mathematical instruction given under the auspices of the Y. M. C. A., to serve for three months, beginning November 1.

Dr. Earl F. Farnau, assistant professor of chemistry at New York University, has been appointed associate professor of organic chemistry at the University of Cincinnati.

DR. ARTHUR M. PARDEE, professor of chemistry at Tarkio College, has been appointed professor of chemistry at Washington and Jefferson College, Washington, Pa.

THE following appointments have been made in the engineering departments at Lafayette College: H. S. Rogers, of the faculty of the University of Washington, has been appointed assistant professor of civil engineering; Ralph S. Wilbur, a graduate of Tufts College and a former member of the faculty at Iowa State University, more recently employed by the Ford Instrument Company, has been appointed assistant professor of mechanical engineering; H. M. Spandau, of Whitman College, Washington, has been made assistant professor in engineering drawing. Charles A. Aey, professor in physics at Allegheny College last year, has been appointed instructor in physics; Landon A. Sarver, a private in the Chemical Gas Warfare Service, and former instructor in chemistry at the Johns Hopkins University, has been appointed instructor in the department of chemistry; Walter G. Kleinspehn, a graduate of Lafayette, '18, is also an instructor in chemistry.

DR. H. H. HODGSON has been appointed head of the department of coal-tar color chemistry instituted two years ago at the Huddersfield Technical College to provide specialized chemical teaching with research facilities for the sudden influx of chemists caused by the great development of the color industry in Huddersfield. Dr. Hodgson has for nearly three years been chief chemist to one of the largest firms of chemical manufacturers in England. He was previously head of the chemical department at the Northern Polytechnic Institute in London.

DISCUSSION AND CORRESPONDENCE

SHALL WRITERS UPON THE BIOLOGICAL SCIENCES AGREE TO IGNORE SYSTEMATIC PAPERS PUBLISHED IN THE GERMAN LANGUAGE SINCE 1914?

IN a footnote appended to one of his latest papers, which appeared in the *Proceedings of the Zoological Society of London,* April, 1918, p. 55, Sir George F. Hampson says: "No quotations from German authors published since 1914 are included. '*Hostes humani generis.*'"

In the columns of *Nature,* issued September 5, 1918, Lord Walsingham, using the above footnote as his text, suggests that "for the next twenty years, at least, all Germans will be relegated to the category of persons with whom honest men will decline to have any dealings," and proposes that scientific men throughout the world shall by common consent agree to ignore all papers published in the German language, not as a measure of "vengeance," but as a measure of "justice." He adds that the truly scientific German, whose labors are worthy of consideration, and who is actuated by sincere love of truth, ought to feel it no hardship to publish the results of his researches in English or French periodicals, especially in the view of the fact that educated Germans are all more or less familiar with these languages.

In justification of his position Lord Walsingham points out the fact, which he, as one of the foremost entomologists of the world, is better able to aver than those less erudite, that in the "Catalogue of the Palæarctic Lepidoptera," published in 1871 by Staudinger & Wocke, "precedence is improperly but deliberately assigned to German names in preference to earlier ones given by French authors"; and he also recalls the persistent manner in which the representatives of German scientific societies at the meeting of the International Zoological Congress at Monaco in 1913 attempted to dominate the discussions, and to insist that German usage in matters of nomenclature should receive universal sanction "to the exclusion of all attempts to trace out the literary history of each species and to preserve for it the name bestowed by the first author who described or figured it." The writer of these lines, who was a member of the First International Entomological Congress which met in Brussels in 1910, recalls quite vividly that the same pushing tendencies and arrogance were also displayed on that occasion by certain of the German delegates.

To the searcher for truth for truth's sake it has been for many years both amusing and irritating to observe the manner in which even in scientific circles Teutonic megalomania has been growing by leaps and bounds. German conceit, originally engendered by the easy victory over France in the Franco-Prussian War, and fostered by subsequent German commercial success and prosperity, spread rapidly from political and military circles into the ranks of scientific investigators. A gullible world, easily duped, accepted the pretensions of these alleged "supermen," not only in the fields of war and mercantile industry, but also in the fields of science. The uninformed and unreflecting attributed to German *sitzfleisch* the honors which belong to *esprit*, mistaking assiduity for genius. Perhaps the most wofully deceived person was the German himself, who, contemplating the results of his compilatory labors, exclaimed after the manner of little Jack Horner "What a Big Boy am I!"

The writer of this note is to a certain extent in sympathy with his two learned friends, Hampson and Walsingham, and at future international congresses is prepared to vote heartily, should they make the motion, for the exclusion of the "Berliner Geck" from gatherings in which said "Geck" may rise and attempt to air himself and his opinions. He has, however, a conviction that in future assemblages of this sort there will be less manifestation of the Prussian spirit than there has been in the recent past. Events are so shaping themselves that our friends, "the supermen," will be inclined to take a position more nearly in accord with the facts of the universe in which they and we live.

The writer, however, can not unqualifiedly give in his adhesion to the proposal to ignore the work of Teuton naturalists unless published in English or French. While it is true that the value of the work done by Germans in many fields has been ridiculously overestimated, nevertheless there is a certain body of men in Germany—unless they have been shot off in recent battles—whose work is worthy of respect. These men naturally write in German. It is their mother tongue, and there are, or used to be, a host of periodicals open to them. If by chance some of them should erect a genus, or describe a species having validity, according to the inexorable "law of priority" the names given by them will have to stand in the future literature of science, and it will not mend matters to pass resolutions declaring that only papers published in English and French shall be taken into consideration by systematic workers. This war is not going to last forever. We hope that Prussian militarism and despotism will vanish from the world, as other nightmares have vanished in the past. We trust that a full atonement for political and military crimes will be exacted. We expect that sanity will return after a while to German crania, and that megacephalic symptoms (they call the disease "big-head" in Kentucky) will abate, and that peace will return to this war-worn world. When that time comes, we will have, to quote Lord Walsingham himself, "to trace out the literary history of each species, and to preserve for it the name bestowed by the first author who described or figured it." It will then not matter whether he was English, French, American, Japanese, or German. It will be, just as it has been in the past, a matter of purely historico-scientific interest. English men of science recognize to-day the scientific names given by Frenchmen who applied them at a time when England was at war with France. English men of science and American men of science will do the same thing in the case of names given by Germans with whose despotic and autocratic powers we are now at war.

The writer loathes despotism and conceit and ignorance and cruelty. The loathing he feels for these things, however, does not blind him to the eternal verities. The essence of science is truth. He can not conceive how scientific truth can be advanced by a resolution that its utterance shall be confined to the English and French languages, though he prefers these languages to German and Choctaw. The adoption of the proposal made by Lord Walsingham would conduce to that state of affairs which he reprobates in the case of Staudinger & Wocke's "Catalogue." Science

in fact is international and universal. There is not an English entomology, nor a French paleontology, any more than there exists a Roman Catholic algebra or a Presbyterian geometry. We certainly have provocation, but the test of our scientific fitness is found in our ability to avoid the mistake of attempting to beat the Prussian by Prussianizing ourselves.

W. J. HOLLAND

CARNEGIE INSTITUTE,
October 18, 1918

THE FOUNDATIONS OF MECHANICS

MR. PAUL J. FOX, in his comments[1] on our article of August 2d seems to us to be mistaken in two particulars. Surely to *identify* a force, so that the same force can be reproduced at will and caused to act at one time on one body and at another time on another body, is not the same thing as to *measure* the force. If we are to compare the accelerations of different bodies due to a given force, some basis of identification of the force is necessary; for example, it may be the force which will produce a certain stretch of a given spring. To identify a force, or a temperature, is not the same thing, by any means, as to measure the force or temperature.

If Mr. Fox will read our article carefully he will see that we do not even imply that the quantitative idea of mass is necessary for either the identification of measurement of force. Every physicist knows, and knew long before Perrin's time, that a rigorous quantitative definition of force is possible in terms of stretched springs without assuming Hooke's law. But no one, perhaps, has ever measured a force in this way, and by *measuring* we do not refer to any kind of thinking nor to any mathematical operation, much as we love both of these categories; we mean a laboratory operation (troublesome though such things be), and especially we mean a laboratory operation which gives an invariant result irrespective of special properties of particular substances and independently of time and place.

Perhaps our deeper source of confusion may be, as Mr. Fox says, "in not making a distinction between mechanics as a 'doctrinal function' and as an experimental science." But we do not believe it; and for Mr. Fox to borrow the term in mild ostentation from Bertrand Russell leaves us unimpressed. Surely it is no mark of fixity of ideas on our part not to take Bertrand Russell over-seriously even in doctrinal mechanics and to always attend carefully to what has been said by Newton and Thomson and Tait, and Larmor.

Our mathematicians are rightly interested in the invariance of all kinds of functions with respect to a wide variety of transformations, and the physicist has seen many remarkable applications of this sort of invariance, the most remarkable of all being the recent generalized form of the principle of relativity; but the mathematician does not seem to understand that there is a kind of mathematics involved in the always more or less idealized operations and transformations of the laboratory with their amazing groups of invariances. Indeed, when we read such passages as the following from Mr. Fox's communication, fear that our mathematicians may never be able to fathom the deeper phases even of doctrinal physics—for the whole of the logical structure of the physical science is, let us borrow the phrase from Bertrand Russell, doctrinal.

"Thus it is clear that the units we have in the Bureau of Standards need not be the same as the undefined elements in the doctrinal function. We do not need even to imagine that Bureau keeping standard springs, rubber bands, strong armed men, etc., any more than it would keep a standard point (!) instead of a standard meter, for Veblen's system of geometry. Any equation may be made use of to measure any quantity which it contains." Mr. Fox, further on, quotes Frederic Soddy's statement that "the conception of force and its psendo physical reality undoubtedly delayed for centuries the recognition of the law of the conservation of energy, etc.," and states that there seems to a certain mysticism in Soddy's contention. Not at all. Let Mr. Fox read and digest the remarkable appendix on The Scope of Mechanical Explanations in Larmor's

[1] SCIENCE, October 4, 1918.

"Æther and Matter," or, an extremely simple exposition of some of the simpler of Larmor's ideas on pages 322–325 of Franklin and MacNutt's "General Physics." Others besides Bertrand Russell have recognized the Doctrinal Function.

W. S. Franklin
Barry MacNutt

SCIENTIFIC BOOKS

The Origin and Evolution of Life, on the Theory of the Action, Reaction and Interaction of Energy. By Henry Fairfield Osborn. New York, Charles Scribner's Sons. 1918. Pp. xxxi + 322. Price $3.00.

Professor Osborn's Hale Lectures, reprinted in an enlarged form in this attractive volume, raise anew the question: are the factors of organic evolution *centripetal*, consisting in the direct "moulding" action of environmental agencies upon the organism? or are they *centrifugal*, the expression of the innate formative and other physiological activities of the germ itself, operating under conditions largely independent of the immediate environment? He perceives, however, that the question can not rightly be put as one of alternatives, but that factors of both kinds necessarily enter. Organism and environment are in continual interaction; what affects the one inevitably affects the other; there is always an interchange of material and energies, constituting a more or less stable equilibrium in a well adapted organism. Organic evolution has had a complex and diversified outcome because the conditions are complex; adaptation, both of structure and activity, has developed as a distinctive feature of living beings because it is an essential condition of the vital equilibrium, *i. e.*, of survival. The factors of evolution are thus various and are classified by the author under four chief heads: (1) action of the inorganic environment, (2) of the organism itself, (3) of the germinal substance of the organism ("heredity chromatin"), and (4) of the living environment, *i. e.*, influence exerted by other living organisms, *e. g.*, competitors. Each of these "four complexes of energy" is to be conceived as itself evolving, partly independently, partly in relation with the others; and the evolution of living organisms has taken place under this fourfold or "tetrakinetic" influence. While the environment, inorganic and organic, *controls* the evolutionary process—permitting the survival only of those organisms which are adapted—the process itself is largely conditioned from *within*, *i. e.*, by the internal or constitutional peculiarities of the germinal substance, which throughout the book is identified with the chromatin of the germcells. Evolution is creative, *i. e.*, novelty perpetually arises, although at varying rates and in varying degree in the different lines of evolutionary descent; but the precise causes and conditions of its appearance remain to be determined; to explain the origin of new varieties a more complete knowledge of the physiology of the germinal substance is required. Paleontological research indicates that variations in the germ can be referred only partly, if at all, to the direct action of the environment upon the entire organism; thus rapid evolution may take place during periods in which there is little geological evidence of extensive natural change, and conversely many forms of life remain stable through the changes and chances of whole geological epochs (p. 137). Paleontology finds one evolutionary line, *e. g.*, reptiles, exhibiting active diversification at a certain period of its history, while at a later periods it relapses into conservatism at the very time when another line, the mammals, develops extraordinary creative activity (p. 231). Evolution, as observed in the paleontological succession of animal forms, often appears to progress in definite directions toward adaptive ends (pp. 146–240),—a fact which would seem to indicate a guidance by natural selection; but selection, while an important condition, can not be regarded as in itself an active agent. Repeated instances occur of characters, at first apparently nonadaptive, continuing to evolve until they become important assets in the struggle for existence. The author inclines to regard the essential agency in evolution as an apparently spontaneous germinal variability. directed along certain definite lines; this "internal

evolutionary impulse "he conceives as mainly determined by the innate properties of the germinal substance, *i. e.*, by "chromatin potentiality" (p. 231). This potentiality determines the rate of appearance and the character of new variations independently of natural selection; for example, paleontology shows that the slowly breeding race of elephants, on which selection might be expected to act slowly, have evolved much more rapidly than the frequently breeding rodents (p. 271). Everything depends upon the "invisible predispositions and tendencies in the ancestral heredity chromatin" (p. 242). There is, however, no evidence in paleontology of an internal extraphysical directive principle or entelechy; on the other hand, environmental conditions appear to exert a direct modifying influence, not attributable to selection, upon the evolving organism, but the nature of this influence remains obscure (pp. 243-244). That the germinal material possesses a power of "adaptive response" to the environment is indicated (*e. g.*,) by the evolution of teeth (p. 257).

In general, therefore, the author refers the evolution of the various metazoön stocks primarily to germinal variations, *i. e.*, more specifically, to variations of an orthogenetic or definitely directed kind in the "heredity chromatin." The evolution of visible bodily form and function is to be regarded as essentially the external sign and symbol of the invisible evolution of the heredity chromatin (p. 151). This "chromatin evolution" has its distinctive peculiarities; it is not "experimental" or hap-hazard but tends to be continuous in one direction toward adaptive ends (p. 146); evolutionary progress is thus not dependent either upon mutations or upon fortuitous variations which are held to a definite course only through the agency of natural selection. In a certain sense the author supports the Weismannian conception that the evolutionary factors act primarily upon the "germ-plasm," rather than upon the "soma"; he recognizes, however, that somatic modifications may secondarily influence the germ; and he appears to favor a kind of qualified Lamarckianism (p. 244); he suggests that possibly bodily changes may influence the germ through the intermediary of hormones (pp. 278 *seq.*). He insists, however, that the factors determining germinal evolution are still for the most part unknown (*cf.* pp. 23, 151).

The problem of the causes of germinal variation is essentially a physiological one. Everywhere in the book the author emphasizes the difference between the somatic and the germinal material, and it seems to the reviewer that this distinction is too sharply drawn. Certainly it can not be maintained in the case of the lowest organisms, *e. g.*, the bacteria or the ultramicroscopic forms of life, in which nevertheless heredity and variation are as truly manifested as in the highest. Such forms multiply or proliferate in a manner which is specific or true to type, but which may be influenced in definite directions by changes (*e. g.*, chemical) in the surroundings; and the same is undoubtedly true of all growing or developing regions in multicellular organisms, including the special germinal material (egg-cell and embryo) at the different stages of its development. Any form of organic growth implies the property of incorporating and assimilating, *i. e.*, transforming specifically, food and other materials taken from the surroundings; this property constitutes in fact the essential or distinctive feature of vital activity; it is common to all forms of living matter and heredity is one of its expressions. Hence the germ-cell can not be regarded as fundamentally different in its physiological constitution and properties from other cells or tissues of the organism. It is true that in higher animals the fertilized egg-cell has special powers of development not normally exhibited by other regions after isolation; but in many lower forms almost any detached portion of sufficient size may act as a germ, *i. e.*, may proliferate under favorable conditions and give rise to a complete organism. The appearance of a sharp distinction between soma and germ in higher organisms is itself a product of evolution; it represents a differentiation which does not exist in the lowest forms of life. Weismann's distinction is based upon the fact that

the germ in multicellular organisms is less readily influenced by environmental influences than the soma; profound somatic modifications may leave the germ-plasm apparently unaffected. There is, however, nothing surprising in this when it is considered that the undeveloped germ forms in most cases only a small and inaccessible part of the total organism; it is usually not subjected to external influences until it separates from the parent and begins its own independent development. But after this has happened environmental conditions may affect the egg and developing embryo just as they affect the adult, and the normal course of development may then be experimentally modified; *e. g.*, cyclopia may be produced in fish embryos, etc. No one can say at what time the protoplasm of the developing germ, whether in the one-celled or many-celled stage, ceases to be germ-plasm and becomes somatoplasm. Just as the rigid distinction between germ and soma can not be maintained, so it is doubtful if the "hereditary material" can be identified with any special single structures or cell-constituents, such as the chromatin. A universal peculiarity of the cellular type of organization appears to be that the nucleus, which always contains chromatin among other constituents, is indispensable to the continued normal physiological activities of the cell, including those specific synthetic processes of which growth and heredity are the most evident expressions. But to regard protoplasm (somatoplasm) as the *expression* and chromatin as the *seat* of heredity (p. 93) does not seem justifiable on physiological grounds. In the specific constructive processes which determine the course of development the physiological activity of the *entire* cell is concerned. To say this, however, is not to deny that there may be a functional differentiation, corresponding to the chemical and structural differentiation, among the various cell-constituents; and that a special significance in relation to the specific syntheses involved in development may attach to the nucleoproteins of the cell-nuclei, *i. e.*, to the chromatin. It is more consistent with modern physiology to conceive of chromatin as an especially active or constant participant in cell-metabolism, with some such special rôle as this, rather than as primarily a reservoir of hereditary determinants.

The consideration of organic evolution leads inevitably to a consideration of the physico-chemical nature of living matter and to speculations regarding its possible mode of origin from non-living matter. In Part I. the author discusses briefly some of the supposed steps in this evolution. He points out that the process must have been prolonged and complex. A prerequisite for the appearance of life was the production of the vital energy-yielding compounds, probably by photosynthesis, as well as of other compounds of colloidal character forming the structural substratum required for the metabolic reactions of protoplasm. To produce a regulated self-maintaining system of this kind, capable of indefinite growth, probably required ages of evolution. The rôle of electrolytes in living matter, and the necessity for special chemical compounds (catalysers, hormones) to control and coordinate the chemical processes of the primitive protoplasm, are among the matters especially discussed in this section. Interesting geological evidence is presented indicating the existence of an abundant unicellular flora and fauna (*e. g.*, calcareous bacteria) at extremely remote periods. This part of the book is highly suggestive, but less complete and authoritative than Part II.

Many striking observations and generalizations are scattered throughout the whole book and a masterly survey is given of the paleontological succession of animal forms. The illustrations are especially interesting, particularly the reproductions of Knight's landscapes, at once imaginative and scientifically exact, showing the prehistoric monsters in their native surroundings.

RALPH S. LILLIE

CLARK UNIVERSITY

SPECIAL ARTICLES

NOTE ON A SIMPLE DEVICE FOR ILLUSTRATING MOLECULAR MOTION

IN experimenting with mercury heated in an evacuated glass vessel, I observed that fine

particles of solid matter on the surface of the mercury were carried away by the evaporating mercury and moved about in the vessel in a very chaotic manner similar to the movement of molecules as postulated in the kinetic theory of gases and vapors. The stream of vapor which carried with it the particles was condensed upon the walls of the vessel and dropped back into the pool in the bottom of the tube.

A simple tube for illustrating the phenomenon is shown in the figure. The tube is about ten inches long and one inch in diameter and contains a small pool of mercury. A small quantity of finely crushed material, such as colored glass or carbon is placed upon the surface of the mercury to form a layer two or

three millimeters deep. Blue glass crushed in a mortar to give pieces about one half to one millimeter in size is found to be very satisfactory since particles of this size are easily visible. Particles of granular carbon or any other light material will do equally well provided that it does not amalgamate with the mercury. The tube is then evacuated and sealed from the pump in the usual manner. The degree of vacuum is not essential provided that it suffices to prevent oxidation of the mercury when the latter is heated, and thus to prevent the mercury from becoming sticky and adhering to the particles. The tubes experimented with were evacuated to a pressure of a few thousandths of a millimeter.

A gradual increase in the temperature of the mercury brought about by holding it over a Bunsen flame shows the following interesting phenomena: At a low temperature the particles begin to move about on the mercury surface. This movement of the particles gives the surface formed by them the appearance of a liquid agitated by convection currents. In this condition the particles have left the mercury surface and are moving about among each other close to the mercury in a layer having a rather well defined surface. A further slight increase in the temperature of the mercury causes some of the particles to leave the layer and to move about chaotically in the space above the surface similar to molecules which have left an evaporating liquid. At the same time the surface formed by the particles becomes indistinct and there is a gradual gradation of density of particles upward from the region just above the mercury. As the temperature continues to rise more of the particles leave the surface and also those which are moving in the space move to a greater height. Finally all of the particles leave the surface of the mercury and move about in the space colliding with each other and with the sides of the tube like the molecules of a gas.

The phenomena just described are more easily produced by first heating the mercury to the temperature at which all of the particles have left the surface and then observing them while the tube gradually cools; the above-described processes then occurring in the reverse order and simulating a condensing vapor. Because of the vacuum in the tube the temperature which is necessary to cause all of the particles to leave the surface is not sufficient to make the top of the tube too warm to hold in the hand. In order to make the particles more easily visible it is desirable to provide a white background by painting or frosting one side of the tube.

The device affords a simple means of illustrating the chaotic movement of a large number of small particles similar to the motion of molecules in gases and vapors. The similarity is especially instructive when compared with the evaporation of a liquid since the effect of the evaporating mercury upon the particles leaving its surface is similar to the actual motion of vapor molecules which leave a liquid.

The phenomenon can be projected upon a screen and the particles and their movement greatly magnified, so that the device may be used for lecture demonstration of the kinetic theory.

E. R. Stoekle

Physical Laboratory,
The Cutler-Hammer Mfg., Company

ABNORMALITIES IN THE CHICK EMBRYO[1]

For the past five years the writer has had under her supervision the preparation of the vast amount of material used for large embryology classes. On account of the possibly controlled conditions under which it could be obtained, the chick was extensively used. Hundreds of these embryos have been examined. Seldom were the eggs incubated for a longer period than three days. For the first two years the pressure to secure material was so great than only the normal embryos of the right degree of development were saved. It was noticed that a large per cent. of the fertile eggs did not give embryos which were satisfactory for class use. The obtaining of an extremely abnormal embryo and two embryos on one blastoderm in a single incubation lead to the saving of all of the specimens. Since that time, over two hundred abnormal ones have been collected.

The abnormalities seemed to occur more in the central nervous system than elsewhere. Two regions were particularly affected, the brain and the neural tube in the region of the last two or three mesoblastic somites and the beginning of the segmental plate. However, the abnormalities did not occur in both of these regions in the same embryo. In embryos obtained from eggs incubated forty-eight hours the abnormality of the neural tube extended over a length of between one eighth and one fourth of a millimeter. The neural tube here was either solid without a central canal or the central canal was extremely small, or there were from two to five canals. This could be recognized in the whole mount as apparent loops of one side of the neural plate, or as a thickened part of the entire tube. The most extreme case of the abnormality of the brain was a seventy-two-hour chick, in which the brain was only about one-fourth the normal size and the fore-, mid- and hind-brains appeared as a series of loops. Another example was a forty-eight-hour chick which had an optic vesicle less than one third the normal size. This optic vesicle was connected with the brain by a stalk more than twice the normal length.

During the past summer Miss Alsop, a graduate student, undertook some experiments upon the cause of these abnormalities. At the same time we were running some controls under normal conditions. She found that she could obtain a large per cent. of abnormalities, and, at will, could produce them either in the brain region or in the region of the tube. She hopes to have a detailed account of her experiments, along with drawings and a more extended description of these abnormalities, ready for publication in a short time.

Mary T. Heaman

Kansas Agricultural College,
Manhattan, Kans.

[1] Contribution from the Zoological Laboratory, Kansas State Agricultural College, No. 22.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, NOVEMBER 15, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

EDUCATION, SCIENCE AND LEADERSHIP[1]

THE British Science Guild has sustained a grievous loss by the sudden death of Sir Alexander Pedler, who for eleven years was its valued honorary secretary. To all the work of the guild he brought wide experience and ripe knowledge. He gave his time freely to its service, and he has been a wise counsellor and a true friend during its early years. He died, as he would have wished, while engaged in work for his country.

Professor Gregory has dealt with our annual report and the objects at which we have aimed in the past year; but there is one matter to which I wish to direct special attention. The war has forced upon us the necessity for efforts to establish the manufacture of many articles formerly obtained mainly or entirely from abroad. Among such products and appliances are synthetic dyes, pharmaceutical and medicinal preparations, glassware and optical instruments, medical and surgical apparatus, and other important requirements alike of peace and of war. The fiction, if it existed, that German science was an essential factor in manufactures of this kind has been permanently dispelled. The guild is organizing an exhibition of British scientific products in order to show what has recently been accomplished by British science and industry. His Majesty the King has graciously consented to be patron of this exhibition and Lord Crewe is its president. The exhibition will be open at King's College next August, and we hope that it will effectively demonstrate the successful application of British scientific research and ingenuity brought into play to meet the needs of the war, as well as prove conclusively that our dependency on Germany in certain departments of industry can be overcome.

[1] Presidential address to the Annual Meeting of the British Science Guild, June 19, 1918.

Last year I endeavored to direct attention to some of the conditions which post-war reconstruction demands, and to indicate the direction in which we must move if we are not only to rebuild our national prosperity, but also to base it on broader foundations, so that it may be shared by every honest worker with hand or brain. Much has happened on sea and land since April of last year, and the war still dominates our activities and absorbs our thoughts. It has now been made plain to us all that the fate of the world will be determined on the western front, as was inevitable. And to the vast majority of the English-speaking peoples it has become clear that no enduring peace—no peace compatible with honor and such as would enable us to begin our great task of reconstruction—is possible until Germany accepts defeat. The Allies have frequently disavowed all desire to crush Germany out of national existence. That idea is a fiction invented, like many others, by her Prussian rulers to induce the masses to bear their growing burdens and to acquiesce in the reckless squandering of their manhood. It is in the general interest that Germany should remain a great power; but the accursed spirit which has been deliberately instilled into the German people—the spirit which is responsible for the greatest catastrophe the world has known, and for the infamies committed by the German navy and army—must be destroyed. Otherwise there can be no rest for mankind, and civilization will perish. The war, with all its cruel losses, sorrows and suffering, must continue until the menace of German militarism has ended and the nations of the world, small and great, are left free to develop in security on their own chosen lines. If ever there were doubts as to the issue, they have been dispelled by the splendid resistance which the Allies are offering to the German masses and by the gigantic efforts which America is making to bear her full share in the battle for human freedom.

In the year that has passed, our plans for reconstruction have made some progress, and we have gained more insight into our national needs. Always, as we seek to weigh our past methods in the balance and to find remedies for the blemishes in our national, political and industrial life, the task before us seems to grow in magnitude and difficulty. And always, if we try to trace the ultimate cause of some failure, blunder, or sign of weakness, we arrive at errors of judgment due either to lack of knowledge or to neglect to apply knowledge that was available if sought. Two of the outstanding tragedies of the war—the operations in the Gallipoli Peninsula and the breakdown in Mesopotamia—have been exhaustively examined, with the result of proving that necessary knowledge was either ignored or not ascertained by the individuals responsible. In other cases, similar investigations must have led to the same verdicts.

The stern necessities of the war have forced upon successive governments the employment of trained non-officials in many capacities. The work accomplished under conditions of extemporization has been marvelous in amount, and it supplies evidence of our innate organizing capacities; but there has been lamentable waste. Government has not always succeeded in using experts to the best advantage. Square men have been too frequently placed in round holes, and in the building up of new departments of state the coordination of effort and the essential principles of sound administration have been palpably lacking. The foresight required to convert a peace-loving people into an armed nation and to fulfil on a sudden all the vast and various demands of the greatest of all wars is necessarily rare; but it can not be said that the best use has been made of the trained intelligence at our disposal, and our political methods have not proved well adapted to a supreme national emergency.

Meanwhile, we have been brought face to face with German efficiency, deadly in some aspects, because concentrated during many years upon deliberate preparation for world conquest. We are only now beginning to understand the meticulous care with which every requirement that could possibly be foreseen had been studied and provided for in advance. In the years before the war, we had often been warned of growing competition in

trade, and it was certainly true that German exports of home production to European countries were rapidly mounting and tending to supplant our own. This was due alike to advantages of position and of communications as well as to the far-sighted policy of the German government. In the general markets of the world outside Europe, however, we were more than holding our own, and Mr. H. H. O'Farrell has shown that in the periods from 1895–99 to 1910–13 we had nearly doubled our superiority to the Germans, owing largely to the magnitude and efficiency of our mercantile marine.

What we failed to recognize was that German peaceful penetration was directed to obtain financial control of certain key industries and vital raw materials in order that, when it was decided to light the fires of war we should be placed in a position of grave difficulty in the manufacture of munitions. A further object was, I am now convinced, involved. It was desired that as many influential persons as possible should be closely entangled in financial interests of which Germany held control, so that during and after war Germans in this country might obtain protection. In no other way can the amazing tenderness shown to Germans, which has given rise to strong resentment, be explained. The treatment of British subjects in Germany, and the liberty accorded to Germans among us offers a most startling contrast.

As little did we realize the strenuous German propaganda stealthily at work all over the world before August, 1911, and since develop with lavish expenditure. Every country of the Allies and of neutrals has felt this malignant influence. Mainly by its agency, Russia has been brought to ruin, and the fair hopes of victory last summer, which we were justified in cherishing, have been deferred. Italy was brought close to disaster by the same means, but has nobly rallied. France is still dealing with the unseen hand, and America has been forced to take drastic measures. Here, as in Ireland and in India, the effects of the most insidious weapons of the German government have been felt, and they have not yet disappeared.

I mention this as a typical example of German efficiency and forethought of a kind which the British nation would rightly have scorned, but which have told heavily in the war and must be guarded against in the future. In the higher regions of statesmanship, that efficiency has inevitably failed. A government which confidently believed that it had the right, by reason of the alleged inherent superiority of the German nation, to force its will upon all other peoples, was naturally unable to understand their mentality; and the arrogance bred of the consciousness of military strength entailed serious miscalculations for which Germany will pay heavily. Impressed with the baseless idea that atrocities, if sufficiently revolting, would intimidate her enemies, the kaiser and his accomplices have succeeded in arraying against themselves all the free nations in the vanguard of progress. They have made the German name and Kultur by words and synonyms of barbarism. They will find that the moral reprobation of the civilized world will dog their footsteps in the years to come, and that the final overthrow of the power of their present governing classes will be the necessary first condition of their readmission to the family of nations. We can learn from German methods what to avoid.

In our projects for national reconstruction there is perhaps a tendency to regard increased industrial and commercial efficiency as paramount. This may be natural, because nothing but a great development of economic production within the empire can restore our heavily burdened financial resources. But, if we read the lessons of this war aright, we must see that this alone can not suffice, and that our industries might be paralyzed by antagonistic forces arising from want of other than purely technical efficiency. Peace will find us face to face with new problems of democracy still unsolved. A huge new electorate will convey political power to masses of men and women for the most part slenderly equipped for the responsibilities which they must assume. Democracy is still on its trial,

and its limitations are frequently forgotten. The masses can never build; but they can always and easily destroy, as the wrecking of Russia, following historical precedents, plainly shows. They can, however, for good or for evil, choose their rulers and displace them when they please. The theory that the intensely complex and vastly important work of modern governments can be continuously inspired by the will of the people is untenable. The hopes of the future depend upon the trained and disinterested leadership of a minority, in the workshop as in the cabinet, and upon the intelligent acquiescence of the majority.

During the war, the duties normally undertaken by government have been immensely extended and not always satisfactorily discharged. It has become more than ever clear that private enterprise and initiative, by which the trade and commerce of the empire were built up, are far more efficient than the agency of government. But there is work to be done which must be entrusted to government and to elected local authorities; and private enterprise will need assistance in certain directions, and some measure of wise control in others. When peace comes, more will be demanded from our governments than they have been accustomed to undertake in the past, and trained intelligence in our departments of state and wherever leadership and direction are required will be the essential condition of successful reconstruction. Of the future of democracy, nothing is certain except that it must inexorably depend upon the character of the acquired knowledge of the leaders whom the enfranchised masses elect to follow. And as the choice of leaders will be decided largely by the moral and intellectual equipment of the masses, the importance of sound and widely diffused education must be vastly enhanced in the years to come. Germany has shown to the world the appalling results of an education directed to Prussianize a great people and to concentrate their minds upon materialistic ideals to be enforced by arms on other nations. Our education must seek to inspire ideals of another kind—the true patriotism which places the national welfare in the forefront of its efforts, which desires nothing at the expense of other peoples, which regards peace as the greatest of blessings and the sure safeguard of the progress of mankind, and relegates force to the righting of wrongs in the last resort.

Since the last annual meeting of the guild, all questions of education have been under discussion, and we now know better where our weakness lies and the entent and nature of our needs. In the number of our institutions providing higher education America alone stands ahead of us. Sir Robert Hadfield has pointed out that Great Britain and Ireland have one university per two and one half millions of population as compared with one million in America. In the dominions, on the other hand, where the population is relatively sparse and the distances great, the proportion is one university to two thirds of a million of people. This numerical comparison is, however, misleading, except that it indicates educational centers capable of extending their activities. The true criterion is the number of students who undergo a complete course of training. Of full time students only 4,400 entered our universities in 1913–14, and of them several hundred were foreigners who would subsequently leave this country. Putting the output of university and technically trained men and women in another way, it appears that per 10,000 of population there were 16 full time students in Scotland, 13 in Germany, 10 in the United States, 6 in Ireland, 5 in England and 5 in Wales. The figure given for the United States includes only students at universities and technical schools of recognized standing. If all students taking four-year courses at such institutions were included the rate per 10,000 of population would be doubled. It is impossible not to believe that these figures help to account for the high standard of intelligence in Scotland and America and for the success of the Scottish and American peoples in many spheres of activity, while the relative backwardness of England, Ireland and Wales must exercise an influence in public life.

The financial test shows a deplorable inferiority to the United States and Germany, and must indicate roughly the relative importance attached to higher education in these countries and our own. Thus the total incomes of state-aided modern universities and university colleges in England and Wales is about £700,000, of which 34 per cent. is derived from parliamentary grants. The corresponding figures for Germany are nearly £2,000,000 and 80 per cent., and the University of Berlin alone receives from the state an annual grant nearly equal to that given to all the university institutions of England and Wales. The annual income of the American universities and colleges is £20,000,000, of which £7,000,000 is at the disposal of the colleges of agriculture and mechanical arts. Private benefactions towards higher education in the United States amounts to more than £5,000,000 a year. With us they do not reach one twentieth part of this sum.

The only possible inference from these figures is that, as compared with the United States and Germany, our higher education is lamentably inferior in quantity. We are not producing trained leadership sufficient for our needs, and the diffusion of knowledge is pitifully inadequate to the requirements of a modern state. If an analysis of the kind of training received by our governing classes were possible, it would be found that scientific knowledge was exceedingly rare and even non-existent in some quarters, where it is essential. Sir Robert Hadfield states that in one important government institution devoted to educational work, about 90 per cent. of the principal officials have received a classical training, and only 5 per cent. have been educated in science. Mistakes and inertia in the direction of public policy and in administration are thus explained. There is not enough knowledge of the right kind in governments, departments of state, or parliaments, while, in the world of industry, a sufficient supply of trained research workers can not at present be obtained. Until this requirement is fulfilled, the development of new industries on a large scale must be impracticable.

The excellent report of Sir Joseph Thomson's committee on the position of natural science in education throws a flood of light on our national deficiencies, and points the way to educational reconstruction. The committee justly claim for sound science teaching that:

> It quickens and cultivates directly the faculty of observation. It teaches the learner to reason from facts which come to his notice. By it the power of rapid and accurate generalization is strengthened. Without it there is real danger of the mental habit of method and arrangement being never acquired.

All thoughtful students of our public affairs must admit that, alike in peace and in war, our leaders in all classes have shown a certain lack of the qualities which science training can impart, and that national interests have suffered grievously for this reason. The power of reasoning from facts and of "rapid and accurate generalization," combined with the habit of "method and arrangement," is the best possible qualification for cabinet ministers as well as for all leadership on lower planes; and the British Science Guild has persistently urged that science should take a prominent place in the education of our public servants.

The committee recall the fact that the neglect of science was noted by a Royal Commission on the public schools more than half a century ago. The position of scientific instruction in the United Kingdom was also surveyed in detail in 1872–75 by a royal commission, of which the Duke of Devonshire was president and Sir Norman Lockyer, the founder of this guild, secretary. But although there has been advance in recent years, it has required the shock of a world war to make us broad to our shortcomings. The champions of classical learning are now moderate in their claims. The Council for Humanistic Studies declares that the future citizen should possess knowledge, not only of the physical structure of the world, but of "the deeper interests and problems of politics, thought and human life," and that he needs "scientific method and a belief in knowledge even more than physical science." This marks a change of attitude, and the advocates of the dominance of science in

education would agree, with the proviso that applications of science unknown to the ancients determine the conditions of health and of economic stability in modern life, and that a "belief in knowledge" and "method" in pursuing it are best inculcated by the study of law in the natural world.

The great merit of Sir Joseph Thomson's Report is that it discloses the present causes of the weakness of science in our education. The universities as a whole now show a bias in favor of science teaching, but there is a deplorable lack of students due partly to weakness in the schools and partly to the influence of scholarship examinations in which classics predominate. Thus the old universities, by their scholarship systems, tend to discourage science teaching in the public schools, and the public schools react upon the preparatory schools. It follows that many of the most intelligent boys are deterred from entering upon a scientific career. It is also possible that some class prejudice, based upon long tradition, dating back to the Rennaisance, may still operate against science training. The recommendations of the committee are wise and far reaching; but I can only give the barest indication of their objects and scope. Nature study in primary schools up to the age of twelve is to be the foundation, and instruction in science up to the age of sixteen is enjoined upon all secondary schools, physics and chemistry to be taught, because all other sciences, to which they should be treated as passports, require some knowledge of them. Mathematics should be connected with science at an early period. The general aims of a science course at school age are defined with a view to secure two educational objects of primary importance: (1) To train the mind to reason about things the boy observes himself, and to develop powers of weighing and interpreting evidence. (2) To develop acquaintance with broad scientific principles and their application in the lives of men and women.

No better foundation for the training alike of the statesman, the leader of commerce and industry, and the manual worker, can be laid down. The committee were strongly impressed with the importance of manual work at school age, and speaking from personal experience I am certain that I owe much to the handling of the file and the lathe before I entered the army, although mechanical pursuits at one time caused me to neglect other studies. I believe that if all classes underwent some manual training there would be a better understanding of the dignity of labor. Rightly distrusting examination tests of conventional type, the committee recommend the inspection of all schools.

Higher standards of teaching power, coordinated training from the primary school to the university and to the post-graduate stage, with a lowering of fees and a liberal allocation of scholarships to be awarded for "intellectual merit and promise," and not in accordance with the results of set examinations—such are the educational ideals which are set before the country. By these means we may hope in time to develop intelligence now wasted, as the committee point out, to supply our present deficiency of experts in all branches of science, and to secure more orderly methods of administration and a higher standard of leadership.

The American Declaration of Independence unfortunately proclaimed without qualification that all men are born "equal," and this theory has proved very harmful. In physical, as in intellectual capacity, men show the extremes of inequality. From the technically entitled "feeble-minded" to the intellectual giant there is an infinitely graduated range of ability in all classes. Heredity may confer some advantage; but genius generally mocks at heredity, and the frequent rise by sheer ability of men from the ranks of manual workers seems to prove that brain power in the case of a fairly homogenous race exists in due proportion in all classes. The object of national education must be to provide, so far as possible, equal chances for natural talent wherever it is to be found. Otherwise, there must be loss of national efficiency. At the same time, it must be remembered that marked intellectual power will always be the possession of a minority, that real leadership will always be rare, and that training in all classes may be wasted if

carried beyond the inherent capacity of the individual boy or girl.

Mass education will at best only approximate roughly to the ideals we set before us; but it can do much by stimulating the available intelligence, and by not only disseminating, but instilling the desire for knowledge, which is the essential foundation of sound judgment and the vehicle of truth. Thus the great education bill which awaits the sanction of parliament will have far-reaching effects upon the national life in the future. Continuity till the age of fourteen at least will provide an increase of school time which can be turned to good account, and will put all boys and girls on one equality; compulsory further part-time training to sixteen and later to eighteen will ensure a minimum of teaching to the whole of our youth, and it will have the great advantage that the state will be able to watch over a critical period during which careers can be made or marred. It is a sad fact that at present many more than two and one half millions of our boys and girls between twelve and eighteen have no opportunity of education and may be neglected in body and soul. Mr. Fisher has made wise provision for physical training, which will help to raise the standard of national health, and if the churches and denominations could arrive at some agreement, it should be possible to inculcate duty and discipline, honor and true patriotism, based on the eternal principles of righteousness.

Whether the bill will secure higher training for the children who show special ability must depend upon numerous scholarships awarded only to those who show fitness, and upon the reduction of university fees in special cases. Of about 600,000 children who now leave the elementary schools annually, only about 1 per 1,000 reaches a university. This is far too low a proportion, and it indicates the denial of that equality of opportunity which must be our ideal. I believe that education attained at some self-sacrifice is enhanced in value to the recipient; but, where there is absolute necessity, it is for the state to ensure that the gifted boy or girl shall not lose the chance of distinction. If the recommendations of Sir Joseph Thomson's Committee are grafted upon the machinery of the education bill, there should be a great increase in the number of science students. The manual workers will not only have no bias against science as a career, but are likely to be attracted towards it. We may hope in future to draw from them a valuable reinforcement to the trained research workers, who will be more and more needed in every department of industry, while they will strengthen the ranks of the leaders of thought in all branches of public and private activity. Education will always depend upon the character, personality and enthusiasm of the teacher, and one great merit of Mr. Fisher's Bill is that it will raise the importance and dignity of the great profession of teaching.

The war has changed the whole outlook of the nation, swept away many prejudices and revealed alike our strength and our weakness. Our fighting men on sea and land and in the air have given to us inspiring examples of patriotism, gallantry and cheerful endurance. In spite of some unpleasant symptoms, the heart of the British people has proved sound and true when tried in the furnace. "The former things have passed away," and our country can never again be as it was four years ago. The reconstruction which lies before us involves political, social and economic changes for which the lessons of the war, if we turn them to full account, can smooth the way. The strenuous work of all classes with hand and brain is the essential condition of industrial regeneration. For well-known reasons, among which want of trust between employers and employed is prominent, our production has been far below that of America. This grave defect must now be removed by shared counsels and frank mutual understanding. Capital and labor are indissolubly bound together by common interests, which are also the interests of the nation as a whole. Nothing except harmonious cooperation, based on good-will and directed by trained intelligence, can ensure the increased and well-ordered production upon which good wages and the social reforms which we all desire absolutely depend. A more equable distribution of wealth will be

a national advantage; but unless wealth is continuously created we can not make good the huge wastage of resources which the war has entailed, and we shall be faced with bankruptcy. Much more is, however, required of us. In the cleansing fires of war, the gold and the dross have been thrown into sharp contrast. If we are to rebuild our national life on purer and healthier lines, so that it may be worthy of the heroes who have fought and died to save Britain from the greatest peril she has ever encountered, the gold must be cherished and the dross must be discarded. The whole future of the empire will be determined by leadership in all classes alike—leadership inspired by self-less motives and based upon patriotism and knowledge.

In the "Wisdom of Solomon" there are words which democracy must take to heart if it is not to prove a disastrous failure. "Neither will I go with consuming envy; for such a man shall have no fellowship with wisdom. But the multitude of the wise is the welfare of the world."

SYDENHAM

AGRICULTURAL TEXT-BOOKS FOR OUR PUBLIC SCHOOLS

ONE of the results of the activities of the agricultural colleges and the experiment stations is the production of an immense quantity of both general and special literature on agriculture. In this literature we find an increasing number of text-books intended for the use in our public schools. This, in itself, may have been influential in stimulating the modern public demand for agricultural instruction in the public schools of both the country and the towns—a demand which is very sane.

It is a matter of common observation of those who have had the opportunity to observe, that nowhere in the old world do we find that interest in the soil and its products among the non-farming classes, or as great a respect among them for the tilling and the tiller of the soil as in America. In many places of Europe, there yet lingers the prejudice of the city dweller against the peasant, who once was tied to the soil and owned by the owner of the soil, for whose support it had pleased God to allow him to exist.

In this country, it is a frequent occurrence to find business and professional men of the city, not only to pride themselves on their skill and experience as cultivators of the soil, but to carry that skill and experience into actual operation in their management of rural affairs. Hence, the teaching of agriculture in all of our public schools of both city and country is an increasing demand. The exact scope of this teaching and to what classes, or what maturity of pupils it is to be applied, seems yet to be an unsettled question, judging from the nature of a large part of the many text-books published for this purpose.

Some of these text-books seem by their style of language to cater to the tended minds of the primary grades, but in their scope and the nature of the topics to be intended as guides for the professional farmer in his practical operations. Agriculture, as a subject in our public schools will fail to educate and intertain the minds of the pupils, if heavily burdened with dry recipes for increasing the number of dollars, or lectures upon mere physical operations of running a farm. The highly interesting biological, chemical and physical principles underlying these operations would, however, not fail to stimulate and elevate the young mind, as adding interest to the operations in themselves. The language, too, in which these subjects are taught, should be in a simple, yet good virile English, and not in the blabber of the baby; for no ambitious boy or girl is willing to stoop to a lower level of intelligence, but anxious to reach out for a higher.

In several of these text-books on agriculture, we find some very strange incongrueties; for example, matters requiring a well developed intellect and considerable maturity of judgment for their comprehension are discussed in a language suitable to the kindergarden tot. One author, in describing the nitrogen-generating bacteria on the roots of the legumes, regrets that he has to use the big word, tubercle; but admonishes his pupils to learn

its meaning and how to pronounce it. Yet, in spite of this supposed immaturity of the minds and the vocal organs of his pupils, this same author manages in his book to treat of all living things of importance on the farm, from the bacterium to the horse, and all the operations, from preparing the soil for the crops to the marketing of their products; nor does he stop at that, but devotes much space to rural sociology.

Another author who feels "that there is a need and a demand for a book that will standardize seventh and eighth grade agriculture" has produced one in which the "arrangements of chapters follow as closely as possible the farmer's seasonal occupations." In his preface, this author says:

Such topics as the origin, history and importance of farm crops and animals are about agriculture, but such topics as how to produce larger yields, use more prolific varieties, the use of high grade and pure bred stock, how to feed well and economically, how to improve the soil, how to combat enemies and how to choose, plan and manage a farm, are topics that deal with making our agriculture productive. This is not primarily a book about agriculture; but on productive agriculture.

If a book dealing with the various natural laws and principles underlying agriculture is a book about agriculture, the author is correct in stating that his book is not about agriculture, nor is it a text-book on agriculture, but a manual giving forth in a dry and matter of fact way directions for the performance of the numerous operations required in the management of a farm. The cost in labor and money, and the profits direct and indirect are, of course, the principle lessons to be inculcated by such teaching.

More attention to the principles of plant and animal life would have added interest and animation to the subject, and more care in the statements concerning facts in plant life would have avoided some obvious blunders. For example, in the table giving the minimum, optimum and maximum degrees, Fahrenheit of the germinating temperature of the seeds of various farm crops, that for the red clover is given as 88°–99° min., 99°–111° optim., 111°–122° maxim.,—Any girl or boy old enough to have begun the study of primary geography, will know that such a peculiarity would banish the red clover from the temperate zone. This book is not the only text-book on agriculture written for the public schools that is encyclopedic in its scope and character, since a great number have been constructed on the same plan.

One author makes the following confession in the preface to his book:

Agriculture is too complex for all the details to be mastered by one person. The expert in crops or soils does not possess more than a general knowledge of live stock, fruit growing and dairying. In the subject of crops, there are those who have specialized in grains, forage crops or grasses. In animal husbandry, there are the specialists in beef cattle or dairy cattle, specialists in draft horses or light horses, and specialists in sheep and swine. If a man attempts to speak out of his own knowledge on all the phases of agriculture, covered by a school text, the treatment of many of the subjects would be inaccurate and misleading, or else so general as to be of little value. To insure for each branch of the subject an expert, who is responsible for a large part of the material in the field of his specialty, the author has organized this material into a logical, teachable work on agricultural science and practise.

The author of this book has by the help of his experts, whose list of names and specialties covers a solid page of his preface, composed a work that is as impossible to teach from, for one teacher, as it was impossible for the author unaided to write it all from his own knowledge. There is no necessity for commenting on the difficulty that would confront the pupils in attempting to master such a text.

Briefly, it may be said that, in the greater number of these "text-books on agriculture for the public schools," the pupils are expected to cover more agricultural subjects, frequently crowded together in an incoherent way and stripped of all philosophical connective tissue, than any student in the state agricultural colleges, where he has a four year's course with specialists for teachers, supplied with all the equipments for demonstration. As a men-

tal nourishment, such a repast, as offered by many of these books, is both too dry and too bulky for digestion,—nor are many cooks an insurance against "spoiling the broth."

What is, then, a logical and reasonable scope for the agricultural teaching and the text book in agriculture for our public schools?

The simplest way out of the dilemma would be to return to the idea of "a book about agriculture" and give up the idea of "productive agriculture" for our public schools. In its place, it would be the object of the agricultural teacher to make intelligible to his pupils, in a general way, those biological, chemical and physical principles underlying our agricultural operations. Hence, agricultural botany and zoology, including a history of the practical phases of the evolution of our "animals and plants under domestication." The practical operations and the history of their evolution should not be lost sight of, but be subordinate to what we might call the scientific aspects, yet diligently drawn upon for the elucidation of these. The subject, thus handled, would not be incomprehensible for one author, or one teacher, or to all the pupils, but be within the scope of the average human mind.

A good text book goes far towards making up for the deficiency of the teacher, and a poor text-book goes equally far in hampering the efficiency of the teacher. Not the least consideration in the value of a text book is its style. A book with a faulty style is like a poorly prepared, or badly seasoned meal, it is taken with a sense of repulsion. There are some of these text books, in which to their small merits are added the demerits of a bad stlye.

H. Ness
Horticulturist, Texas Experiment Station,
College Station, Texas

FRED SILVER PUTNEY

Fred Silver Putney, professor of experimental dairy husbandry at the Pennsylvania State College, and well known among dairy professors and investigators throughout the United States, died of pneumonia at his home in State College, Pennsylvania, on October 5, 1918.

Always interested in live stock problems, in recent years he has devoted his energies to teaching and fundamental research along the lines of animal nutrition. Dairy cattle feeding problems have been his special interest and his work along these lines is well known. He is co-author with Dr. C. W. Larson of the text-book and general reference work, "Dairy Cattle Feeding and Management," and in conjunction with Dr. N. P. Armsby, of the bulletin, "Computation of Dairy Rations," in addition to numerous papers on dairy management and nutrition.

Professor Putney was born in Hopkinton, N. H., on November 10, 1881. He was graduated from the Concord High School in 1901 and received the B.S. degree from the New Hampshire State College in 1905. In 1908 the Pennsylvania State College conferred upon him the degree of Master of Science, and he had completed recently the requirements for his doctorate degree at the University of Wisconsin.

Professor Putney first went to the Pennsylvania State College in 1906 where he worked with Dr. H. P. Armsby as an assistant in animal nutrition and general experimental work until 1908. That year he became assistant to Dean F. B. Mumford, of the college of agriculture, University of Missouri, at which institution he continued his studies in nutrition towards a doctorate degree. From Missouri he went to the Rhode Island State College as professor of animal husbandry and head of the department, and he remained at that institution for several years. In 1913 he returned to the Pennsylvania State College as assistant professor of dairy husbandry, and later became professor of experimental dairy husbandry.

For the past years, Professor Putney has been on leave of absence for advanced study in animal nutrition. This time he spent at the University of Wisconsin and had just completed the requirements for his doctorate degree. Professor Putney married Miss Bertha Bond of Urbana, Illinois, September

2, 1911, and they have one daughter, Ellen Ayers Putney, who was born July 6, 1917. Professor Putney was a member of the American Association for the Advancement of Science, the Dairy Science Association, Alpha Zeta, Theta Chi, Acacia and the Order of Free and Accepted Masons. Just in his prime and in the fullness of his powers, the loss of Professor Putney will be keenly felt by his wide circle of friends and associates in dairy work. He had that rare combination of practical common sense combined with research ability which enabled him to keep a proper balance in all problems of a research nature. By his death, science has lost a well-trained and efficient worker.

VON ADOLF ERICH DAECKE

Von Adolf Erich Daecke—born in Germany, place and date unknown—died at Richmond, L. I., New York, on October 27.

He was entomologist to the department of agriculture of the Commonwealth of Pennsylvania. His work in the New Jersey Museum Reports of 1905–7 and 9 on Diptera was excellent—his knowledge of the Odonata was quite accurate. His name is immortalized in the family of Pipunculidæ in the specific name of the genera *Nephrocerus daeckei*. His nature was very kind, as was shown by the manner the squirrels in Capitol Park upon the sound of his voice or footsteps would spring toward and climb over him, awaiting a word and a caress—when he spoke to them they seemed to comprehend his conversation, his affection for children was wonderful and they were so pleased when he told them of the superficial observation of insects and animals they never seemed to tire of his discourses made so plain by him.

He was a devoted fellow of the Harrisburg, Pa., Natural History Society; from the membership he formed excursions along the byroads and brooklets and over the mountains searching for the local avi- and zoo-fauna; his enthusiasm added many more to its membership. The charm of his interest in his students endeared him to them while his attainments were equally fascinating to them.

He was a member of the Entomological Section of the American Association for the Advancement of Science and attended its meetings with the vigor of youth, although a man in the fifties, was also a member of Academy of Natural Sciences, Philadelphia, and several scientific societies on the European continent.

He was a sincere friend and generous to a fault—was uncommonly fair in scientific discussion. However, he had very decided views of the superiority of the Germans; he could not read English without a curious disturbance overcoming his usual affability. H.

SCIENTIFIC EVENTS

THE UNITED STATES PUBLIC HEALTH SERVICE AND THE INFLUENZA EPIDEMIC[1]

With the widespread occurrence of influenza in the vicinity of Boston, and the unmistakable signs of its beginning elsewhere, urgent calls were addressed to the United States Public Health Service to furnish medical and nursing relief to stricken communities. All available regular officers were detailed to the stricken communities, but the number available for such detail was insignificant compared to the urgent need occasioned by the epidemic. Moreover, the bureau had no nurses available for service in epidemic.

In this emergency the Surgeon General called upon the Volunteer Medical Service Corps, the Red Cross, the medical and nursing professions as a whole, and on the general public for personnel to help combat the epidemic. At the same time Congress was appealed to for a special appropriation to meet the expenditure required by the emergency. The necessary funds were promptly voted.

In response to the request for physicians available for duty in the Public Health Service, the Volunteer Medical Service Corps compiled a list of over 1,000 names classified by states. Appointments were offered by tele-

[1] Publication authorized by the U. S. Public Health Service.

graph to these physicians by the Public Health Service, and within forty-eight hours groups of physicians were on their way to some of the stricken communities in New England, where the epidemic at that time raged most severely. Soon after, similar medical units were sent to New Jersey, New York, North Carolina, and to Phœnix, Ariz.

The problem of supplying nurses was much more difficult, for it was found almost impossible to discover nurses or trained attendants who were not already extremely busy on urgent medical work. Nevertheless, a limited number of nurses and trained attendants was secured by the American Red Cross and mobilized for emergency service in the communities most severely affected. In addition to this the attention of local communities was called to the valuable nursing work which could be rendered by intelligent volunteer workers, such as school teachers, especially when they are directed by trained graduate nurses. In many communities the organization of this group of nursing personnel has done much to relieve the serious emergency caused by the lack of trained nurses.

It was made clear from the outset that the United States Public Health Service desired to aid and not supplant state and local health authorities in their work. Accordingly, instructions were issued that all requests for medical, nursing, or other emergency aid in dealing with the epidemic should come to the United States Public Health Service only through the state health officer. Moreover, as soon as possible all this epidemic work was organized on state lines with a representative of the United States Public Health Service detailed to each state to secure the best possible organization and coordination of health activities of the service, in others the executive of the State board of health has been given appointment in the United States Public Health Service as field director.

While the activities of the doctors and nurses working under the Public Health Service are generally limited to those ordinarily regarded as preventive health measures, emergency conditions in some communities have been such that much medical relief work has had to be undertaken. This was the case, for example, in several communities where the few practicing physicians were themselves stricken and where the people were in urgent need of medical attention.

FOREIGN DELEGATES TO THE AMERICAN CLINICAL CONGRESS

A PARTY of eminent surgeons from abroad, who came to the United States to attend the Clinical Congress which was given up on account of the influenza epidemic, has been making a tour accompanied by Lieutenant-Colonel George E. Brewer, M. C., U. S. Army, New York City; Colonel William J. Mayo, M. C., U. S. Army, Rochester, Minn.; Colonel Franklin H. Martin, M. C., U. S. Army, Chicago, and Dr. Pilcher, New York City. They have been entertained and have delivered addresses on various phases of military surgery in St. Paul, Rochester, Philadelphia, Chicago, New York, and other cities. The party consists of Colonel Sir Thomas Myles, Dublin, Ireland, Major G. Gray Turner, New Castle-on-Tyne, England, Colonel George E. Gask, St. Bartholomew's Hospital, London, Professor Raffaele Bastianelli and Major Pouletti, Rome, Major Pierre Duval and Lieutenant Henri Beclere, Paris, and Major Poillet, Ambre, France.

On November 6 they were the guests of the New York Fellows of the American College of Surgeons at a dinner at Delmonico's, presided over by Dr. J. Bentley Squier, the feature of which was the conferring upon the visitors of honorary fellowship in the college.

According to a press notice Dr. Squier, presided at the dinner. He reminded the gathering, including several hundred of the best known medical men here, that the clinical congress was to have undertaken important work in this country in October, but that the formal sessions had to be abandoned before the congress was convened because of the influenza epidemic.

Dr. Squier then introduced Colonel Franklin Martin, who related briefly the incidents of the delegates' journey. They went first to

Washington where they were received by President Wilson and his Cabinet. Then they traveled to Camp Greenleaf, the medical training camp where, Colonel Martin said, they presented the technical papers which were to have been read at the conference. Next the delegates went to St. Paul, Minn., where they visited the Mayo Clinic after which they went to Chicago, Philadelphia, and other important cities.

Colonel Martin introduced Colonel William J. Mayo, president of the American College of Surgeons, and then the candidates for honorary fellowships filed by the speaker's table, the little procession being led by General Ireland. He was escorted by Major General William C. Gorgas. As each member reached Colonel Mayo he halted long enough for Dr. Mayo to cite the achievements of the candidate.

General Ireland in his speech said that the fellowship was an unexpected honor and that he would treasure it as a trust to be held for the thousands of medical men of the American Army. Turning to a discussion of American Army medical experience abroad, General Ireland said wartime treatment of the sick and wounded had proved different in this war, and he paid generous thanks to the medical officers of the Allies for their aid to the Americans. Not only were the Americans taken to front-line formations and instructed, but important medical officers of the allied armies came monthly to the Research Council in Paris, thereby enabling that body to "do ineffable good and save countless lives." "American medical officers in France," General Ireland added, "have labored in France under many difficulties. Much of France's resources had been exhausted when we got there, and it was a splendid spirit with which our American doctors took up their great task. I think I may say that the achievement of American medical officers in France will add a bright page to American medical history. We still are short of personnel and material due to a lack of tonnage, over which we have no control, but I am confident these difficulties will be overcome in time to enable us to accomplish all that lies before us."

DIVISIONAL OFFICERS OF THE AMERICAN CHEMICAL SOCIETY

THE Divisions have elected the following officers for the ensuing year:

DIVISION OF INDUSTRIAL CHEMISTRY AND CHEMICAL ENGINEERING

Chairman, Harlan S. Miner; *Vice-chairman*, H. D. Batchelor; *Secretary*, H. E. Howe; *Executive Committee*, W. F. Hillebrand, S. W. Parr, A. W. Smith, David Wesson, J. G. Vail.

DIVISION OF BIOLOGICAL CHEMISTRY

Chairman, I. K. Phelps; *Vice-chairman and Secretary*, R. A. Gortner; *Executive Committee*, W. D. Bancroft, C. L. Alsberg, W. J. V. Osterhout, H. S. Grindley, Frederick Fenger.

DIVISION OF ORGANIC CHEMISTRY

Chairman, Lauder W. Jones; *Vice-chairman and Secretary*, Harry L. Fisher; *Executive Committee*, R. F. Brunel, Wm. J. Hale, O. Kamm.

FERTILIZER DIVISION

Chairman, L. L. Van Slyke; *Secretary*, F. B. Carpenter; *Executive Committee*, R. N. Brockett, H. J. Wheeler, C. H. Jones, E. W. Magruder.

DIVISION OF WATER, SEWAGE AND SANITATION

Chairman, Robert Spurr Weston; *Vice-chairman*, J. W. Ellms; *Secretary*, W. W. Skinner.

DIVISION OF PHARMACEUTICAL CHEMISTRY

Chairman, F. O. Taylor; *Vice-chairman*, H. W. Rhodehamel; *Secretary*, G. D. Beal; *Executive Committee*, E. B. Carter, H. C. Fuller, Herman Engelhardt, W. D. McAbee.

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY

Chairman, W. E. Henderson; *Secretary-Treasurer*, W. A. Patrick; *Executive Committee*, H. P. Talbot, E. C. Franklin, C. James, R. B. Sosman, J. N. Swan.

DIVISION OF AGRICULTURE AND FOOD CHEMISTRY

Chairman, W. D. Richardson; *Vice-chairman*, C. A. Browne; *Secretary*, T. J. Bryan.

SCIENTIFIC NOTES AND NEWS

THE degree of doctor of laws has been conferred on five members of the British Educa-

tional Mission at a faculty convocation of the University of Michigan. Those thus honored are: Dr. Arthur E. Shipley, the Rev. Edward W. Walker, Sir Henry Miers, Sir Henry Jones and Dr. John Joly. The degree of doctor of letters was conferred on Miss Caroline Spurgeon and Miss Rose Sidgwick.

In recognition of his distinguished services in behalf of military sanitation, Major General William C. Gorgas, until recently Surgeon General United States Army, has been made a grand officer of the Order of the Crown of Italy. The ceremony of presentation took place on November 5, in the office of the Surgeon General, the order being presented by Major General Emilio Guglielmotti, military attaché of the Royal Italian Embassy.

In addition to the silver service which was given to Dr. M. C. Whitaker on his retirement from the presidency of the Chemists' Club, an illuminated memorial, designed by Mr. Edward B. Edwards, has also been presented to him. The center is a Latin text written by Professor McCrea, of Columbia University, and the border decoration consists of portraits of Gerber, Bacon, Lully and Paracelsus in the four corners and alchemistic symbols worked into a decorative design.

Dr. Frank Schlesinger, director of the Allegheny Observatory, chief of the Department of Aeronautical Instruments, Engineering Division, Bureau of Aircraft Production, at Dayton, Ohio, has been elected a member of the Societa Spettrocopisti Italiani.

Mr. William deC. Ravenel has been placed in charge of the administration of the National Museum, with the title of administrative assistant to the secretary of the Smithsonian Institution, and in addition to the general duties of that office has been designated director of the Arts and Industries branch of the museum. He is a native of South Carolina, was educated at Union College, and has been connected with the museum since 1902. For many years he served as assistant in the United States Bureau of Fisheries, in charge of fish culture, and was acting commissioner at various times from 1896 to 1902. He represented the Bureau of Fisheries and the National Museum at all national and international expositions for many years, and was secretary of the United States Government Board of the Panama-Pacific Exposition at San Francisco in 1915.

Mr. Edwin H. Pagenhart, hydrographic and geodetic engineer of the U. S. Coast and Geodetic Survey, has been transferred to the Corps of Engineers (Reserve) of the army, with the rank of captain.

Mr. Edward P. Bartlett, formerly assistant professor of chemistry at Pomona College, Claremont, Cal., has been commissioned captain in the military intelligence branch of the Army.

Dr. Thomas Buck, assistant professor of mathematics at the University of California, has been commissioned a first lieutenant in the ordnance department of the army, and will be located in Washington doing research work in ballistics.

Dr. C. A. Brautlecht, professor of chemistry in the Florida College for Women, has been called into the Sanitary Corps as first lieutenant. He is stationed at the Rockefeller Institute for Medical Research in New York City.

Mr. H. Lyle Smith, instructor in mathematics at Princeton University for the past two years, is now in the office of Major F. R. Moulton, of the Ordnance Department at Washington.

UNIVERSITY AND EDUCATIONAL NEWS

The trustees of the New York Polyclinic Hospital have proposed to transfer the property of that institution to Columbia University, to be maintained for the public service and for advanced instruction and research in medicine and surgery. Polyclinic Hospital, which was built in 1912, has a capacity of 300 beds, with ample provision for private patients. It is due to Dr. John A. Wyeth and

a group of friends, who started a movement to establish a hospital for advanced study and investigation.

AT a recent meeting of the British Textile Institute, at Bradford, it was announced that the aim of the promoters was to obtain a financial backing of £50,000. Donations amounting to close on £7,000 were acknowledged. The aims of the institute are to extend the scope of the institute are "to extend the scope of the technology of the textile trades, to establish and maintain lectureships, to encourage invention and discovery, to promote the standardization of tests, and to provide the essential *liaison* between the business and the scientific mind."

THE total number of students of medicine enrolled in the five universities of Switzerland in the summer semester of 1918 was 1,725. They were distributed as follows: Bâle, 220 (174 Swiss, of whom 15 were women, and 46 foreign, of whom 4 were women); Berne, 385 (242 Swiss, of whom 29 were women, and 143 foreign, of whom 16 were women); Geneva, 381 (163 Swiss, of whom 16 were women, and 218 foreign, of whom 58 were women); Lausanne, 225 (159 Swiss, of whom 13 were women, and 66 foreign, of whom 16 were women); Zurich, 504 (350 Swiss, of whom 56 were women, and 154 foreign, of whom 16 were women).

PROFESSOR JAMES THERON ROOD has resigned as professor of electrical engineering of Lafayette College, to take up the professorship of railway electrical engineering in the department of transportation at the University of Illinois.

MR. M. CANNON SNEED, formerly assistant professor of chemistry at the University of Cincinnati, has been appointed associate professor and head of the division of general and inorganic chemistry at the University of Minnesota.

DR. SHIRO TASHIRO has been made an assistant professor in the department of physiological chemistry of the University of Chicago.

DR. F. D. MURNAGHAN, of the Rice Institute, has been appointed associate in applied mathematics at Johns Hopkins University.

I. NEWTON KUGELMASS, formerly with the departments of chemistry at the College of the City of New York and Columbia University, has been appointed professor and head of the department of chemistry in Howard College in Birmingham, Alabama.

ON account of the death of Associate Professor William G. Mallory, Dr. S. R. Williams, head of the department of physics, who was spending his sabbatical year in research under the auspices of the Federal War Department has returned to Oberlin College and has resumed teaching.

DISCUSSION AND CORRESPONDENCE

INSIDIOUS SCIENTIFIC CONTROL

AN interesting letter by G. A. Miller in SCIENCE, August 2, 1918, page 117, calls attention to the necessity for the vigorous development of science at this time, and to the danger that we may win the war in the military sense, only to find ourselves dominated by German knowledge and German science, because of the fact that the Germans have continued their scientific work during the war, whereas in the United States, England, France and Italy, the activities of scientific men have been turned toward war problems, as was necessary from the great lack of preparation for war in these countries, and as was not necessary in Germany, owing precisely to the great preparations which had been made.

Much has been said and still more assumed during the past two decades in regard to the German proficiency over and above that of other peoples in all realms of science; and it has been the feeling of many teachers and of many students that the German language was more essential for scientific uses than any other, and that the German training was the one to which our graduates who were not satisfied with what they found in this country should turn. This American feeling was undoubtedly expressly fostered by the German government, and probably will again be fos-

tered by it. Any government should foster any plan that would lead to the high regard of its country in scientific matters, and especially in regard to the advanced training of the young. The French and English have been too indifferent to the advantages of having American students come to them for their doctorates. The United States can hardly hope to attract many European students in the next few years, but the institutions and the government of the United States should foster the advent to our country of large numbers of Chinese and Japanese students; their number is already considerable, but should be studiously augmented.

This sort of scientific control is subtle, and if turned to bad uses, may become insidious; but is almost certain in the case of a democratic country like ours to escape misuse, and to realize many useful objects.

Why should our scientists look to Germany and to the German language as necessary for scientific advance in this country? It seems to me that the German advances in science are not themselves alone responsible, not perhaps even a small part of the reason, for our past devotion to Germany. The fact is that any scientist must have the means himself readily to look up the literature on any scientific subject; and the fact is that the great compendiums of science, the great yearly reviews of scientific progress, are made by Germans, and published in the German language. It is impossible for a mathematician to work to advantage without being able to consult the *Jahrbuch für Mathematik*. The *Revue Semestrielle* will not alone suffice, nor is it necessary. It is impossible for a physicist to work without consulting the *Fortschritte der Physik; Science Abstracts* are not sufficient. And so it is in many other fields of science. The physicist must consult Winkelmann's "Handbuch der Physik"; there is no real English or French equivalent. The "Mathematical Encyclopedia" commenced its publication as a German compendium indispensable to the mathematician; fortunately, an improved edition was soon taken up in France.

In my opinion, whatever country takes care of the preparation and publication of the best reviews of progress in science, and of the best compendiums of scientific knowledge will inevitably be regarded by other countries as an essential for scientific development, and the language of that country will have to be taught to all young scientists. This, again, is subtle control, which may be used for good or bad, according as it is exercised for good or bad motives. That the government of Germany was alive to the possibility of this control seems patent; and that they expected their insidious control to be serviceable to them in swaying opinion in this country in their favor during this war is equally manifest from many points of view.

Are the English-speaking peoples of the world to return at the close of the war to the well-nigh complete dependence on Germany for their standard scientific reviews and handbooks, and thus make necessary the learning of the difficult German language for all young scientists?

Irrespective of how this question may be answered, the learning of the German language, like that of any foreign language, will always be valuable to scientists. I have myself, for example, been obliged to read during the last ten years German and French constantly, Italian very frequently, Dutch, Spanish, Norwegian and modern Greek occasionally, and I have regretted the fact that I could not read Russian. All linguistic attainments can be put to useful ends by any one interested in science, and all linguistic failures are from time to time an annoyance. I am, therefore, not asking whether it is desirable that young men should be able to read German. Of course it is; but I am asking whether they shall be compelled to read German, whether or not they read any other language.

The preparation of yearly reviews of the advance in science and of great compendiums of past scientific progress is a matter which requires organization, industry and cheap intellectual labor. There seems to be plenty of cheap intellectual labor in this country, and plenty of organizing ability, and probably sufficient industry in the work could be obtained. The

advantage of having such books printed in English would be much greater than that of having them printed in German because the number of English speaking people is much greater than the number of those who speak German as a native language. The regions of the world in the control of the English-speaking peoples are very extensive, and well situated to sustain a large population, so that the disparity between the number of English-speaking people and the number of German-speaking people is bound to increase rapidly. With the stimulus that this war has given to scientific and engineering work, with the emphasis that it has laid on the necessity for a country to be thoroughly developed in science and engineering, the chances are that the English-speaking peoples will give greater relative attention in the future than in the past to science and engineering. It may therefore be inferred as probable that the number of English-speaking people using reviews and handbooks will be considerably greater than the number of German-speaking people. Moreover, English is not a difficult language for a foreigner to learn to read.

In an Executive Order issued by President Wilson on May 11, 1918, the National Academy of Sciences was requested to perpetuate the National Research Council, the duties of which should be as follows:

1. In general, to stimulate research in the mathematical, physical and biological sciences, and in the application of these sciences to engineering, agriculture, medicine and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare.

2. To survey the larger possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects.

3. To promote cooperation in research, at home and abroad, in order to secure concentration of effort, minimize duplication, and stimulate progress; but in all cooperative undertakings to give encouragement to individual initiative, as fundamentally important to the advancement of science.

. . . .

6. To gather and collate scientific and technical information at home and abroad, in cooperation with governmental and other agencies and to render such information available to duly accredited persons.

It seems to me as though the National Research Council could not adequately fulfil the duties assigned to it by the President of the United States as enumerated above without undertaking the organization of the publication of yearly reviews of the progress in science and engineering and of occasional compendiums of knowledge already acquired and digested. How otherwise can the council better stimulate research, better afford a survey of the larger possibilities of science, better promote cooperation in research, or more effectively gather and collect scientific and technical information? Moreover, by so doing the council would displace the insidious control of Germany which has been developed into a propaganda not at all flattering to our scientific value, and actually dangerous to the national defense.

Edwin Bidwell Wilson
Massachusetts Institute of Technology,
Cambridge, Mass.,
October 23, 1918

NEMATODES ON MARKETABLE FISHES

The attention of the writer was called to the problem of attacks of nematodes on marketable fishes while on a visit to Norway during the year 1917. The visit was extended to the northern part of Norway, where the writer came in direct contact with fishermen and had the opportunity to study the problem at close range. The villagers in northern Norway are dependent upon fish to a large extent as a diet. When the writer was there, he frequently heard it remarked when purchase of fish for a meal was to be made: "Don't get one with 'kveisa.' Get fat ones." "Kveisa" is the common name given by the people to round worms found on the liver and stomach in fishes.

Various food fishes common to the coast of Norway, such as *Gadus virens, G. callarias, G. æglefinus, Lycodes esmarckii, Molva vulgaris, M. byrkelange, Brosmius brosme, Hippoglossus vulgaris, Pleuronectes platessa, P. limanda, Sebastes marimus* and others have round worms on the liver; but only those that commonly live near the coast or in shallow water, such as *G. callarias* and *G. virens* seem to be considerably affected.

When many round worms find their way into the muscles of the body of the fishes its health is impaired. The nematode lodges itself between the metameres of the muscles where it becomes encysted. The effect on the fish is marked. Those with a considerable number of intermetamerically encysted worms become sluggish in movements and in time are not able to chase their food. Consequently these fish become an easy prey to their enemy. Examination of several specimens of *G. virens* and *G. callarias,* from various localities, showed that the muscles of apparently healthy specimens were also infected. Fortunately the larger fish on the coast of Norway have not, as a rule, many enemies among themselves; but if the nematode invasion becomes too great they may succumb from lack of ability to catch their own food. This is particularly true of carnivorous species. On the other hand, smaller specimens, if infected, are easily preyed upon. The cause for this disease must be sought in the diet of the fish.

Seventeen years ago, when the writer was a resident of northern Norway, this disease among food fishes was unknown to the consumer of fish. Kveisa were always known to be on the liver, for they could be readily seen; but they were not considered to be of any consequence. If the liver was prepared for table use, which is commonly done when it is obtained absolutely fresh, its capsule and trabeculæ were removed together with the kveisa. But if the consumer at dinner time finds kveisa in a morsal of fish he naturally loses his appetite at once. This in consequence interferes with the use of such kinds of fish as a diet. In fact, newly caught codfish which formerly were one of the most tempting offers to any family table, had little chance in 1917 at the villages of Rörvik i Namdalen, Brönnöy, Sandnessjöen and Stokmarkness. The people knew that the fish were diseased and did not care to buy them.

The fishing industry has been one of the largest industries in Norway for many years. The intestines have not been utilized except by farmers, in northern Norway, who use them as fertilizer. Those people, however, who depend entirely on fishing for their living throw the intestines overboard when the fish is sloughed. It is probable that healthy fish by feeding on infected viscera acquire so many of the parasites that they succumb to their injurious effects.

Along the coast of Norway, the younger generations of shore cods (*Gadus callarias*) and bluefish (*Gadus virens*) commonly seek shallow water for feeding purposes. At fishing villages where a great deal of cleaning of catches takes place the young fish find ample food from discarded intestines, and as all the viscera are as much inffected as is the liver, it may be fair to assume that this material is the cause of the nematode infection.

It is conjectured that when food gets scarce and the vitality of the fish decreases the effect of the nematode inroad is increased. This was indicated by the fact that all of the poorer specimens, of the species *G. callarias* and *G. virens,* which were examined, were much more infected with nematodes than were the healthier ones.

It may be fair to assume that the attack of nematodes on marketable fishes in Norway may become an economic problem of considerable importance. If, however, it is proved that the worms found in the flesh are of the same species as those commonly found on the viscera, the present extensive infection may be remedied by stopping the feeding of young fish on infected viscera. The danger of this infection does not lie in transferring the nematode parasite to man, for that is improbable, but it is unpleasant to eat worms. The problem is, to what extent will the disease diminish the use of nematode infected fish as a diet; and decrease the number of the

species involved, and how may the disease be eradicated?

H. P. K. Agersborg
Hoagland Laboratory,
Long Island College Hospital,
Brooklyn, N. Y.

PAPERS "TO BE PUBLISHED"

It seems to the writer that one of the most annoying things in looking up the literature on a subject is to come across the statement that the particular point one is interested in has been worked out by some previous writer but publication was postponed for some reason. For example, in 1903 this statement appeared: "The embryology of the corn grain was studied and figures were made of the ovule at different stages beginning with the archesporial cell and ending with the fully developed embryo. These drawings and observations not being complete will be reserved for another paper." Two or three workers have recorded the fact that their search for a more recent paper has been in vain, and have remarked on the needlessness of sending them on a wild goose chase.

Another example, published in 1912, is even more serious than the one quoted above. It also concerns maize, and is as follows: "The writer has evidence (not yet published) upon various strains of pod varieties and their hybrids with other podless varieties to show that the pod character, in that form, never was a normal or original pod or glume in *Zea*; and it is also evident that the new branched ear, as it is, is not a reversion to a former one." Here the writer records important conclusions without giving any evidence on which to found them. Of course they carry little weight as they stand, but simply cloud the question at issue. They seem to have been put forth simply to gain priority without the effort being made to substantiate or record the facts back of the conclusions. This seems to be the case, especially when years elapse before the "evidence" is published, as in the case in point.

Undoubtedly many other similar instances could be cited, but these two are sufficient to illustrate what is meant. It is probable that at the time the above were written the authors really expected to follow shortly with second papers, but through some unforeseen circumstances they had to postpone their publication indefinitely. From the viewpoint of the person following up, would it not be better to omit statements as to future efforts and future conclusions and save them for the papers "to be published"? It is probably true that some results worthy of note have come from following up "leads" of this nature, but scientific courtesy forbids the pursuit of such a hint until a more than reasonable time has elapsed after publication, and even then the average person does not care to work on problems where priority claims have been made upon conclusions one may reach.

Horace Gunthorp
Washburn College,
Topeka, Kans.

QUOTATIONS

MASKS IN GAS WARFARE

The masks now used are nearly all of the canister type: that is, the inhaled air is drawn in through a canister containing certain materials which will react with, or absorb, the gases before they enter the mask itself. This mask consists of a close-fitting fabric, containing usually more or less rubber in its structure, and held in place by elastic straps over the head. The exhaled breath escapes from the mask through a rubber valve which opens only from pressure from the inside. The time allowed to put on the mask, when slung by a strap from the neck, is under ten seconds. It is carried in a canvas case, and when the forces are within two miles of the front, they are required to wear the outfit in the "alert" position, ready for instant use, night and day.

An important feature which has been the occasion of much scientific study is the eye piece of the masks, to avoid dimming from the moisture accumulating within. Anti-dimming preparations have been found, and lately, as the result of many experiments, materials devised which reduce this difficulty to a minimum, under ordinary conditions of use.

Great improvements have been made in the effectiveness of the absorbent materials used in the canisters, and this, in turn, has increased several fold the general efficiency which it was possible to attain at the time when the manufacture of the masks was first undertaken, and hence to diminish the amount of material to be placed in the canisters. The significance of this will be understood when it is realized that there is a considerable friction to overcome when the inhaled air is drawn through the canister. This was so great in the earlier masks, that it made necessary a suction on the part of the wearer of the mask equal to that required to raise a column of water in a tube to a height of six inches; an effort not incomparable with that made by many asthmatic sufferers to draw air into the lungs. This frictional resistance has been materially lessened by the improvement in the protective materials, and every reduction, however slight, is a great boon to the troops. The materials used in the canisters are selected to react with gases of an acid character, and with those capable of destruction by oxidation, a process like that generally known as combustion. Much reliance is, however, placed upon the absorptive power toward gases exhibited by many porous substances, notably, high grades of charcoal. The principle is the same as that utilized in the "charcoal filters" sometimes attached to our faucets to clarify water supplies.

Of late a new problem has been presented, because of the use of gases in the form of "smoke-clouds," which easily pass through the protective materials contained in the canisters. This has necessitated the addition of another filtering medium, and has necessarily added somewhat to the resistance to be overcome.

How serious this "neutralization" of troops through the continuous wearing of masks may be, is illustrated by the condition which obtained before one of the recent violent attacks on the Western Front. It has been stated that the enemy fired gas-shells (mainly mustard-gas) at the rate of two hundred thousand shells per day for four days, each shell probably averaging about five pounds of material. While the gas-masks will protect the wearer from the inhalation of this gas, they must have required one or more renewals during this period. This attack was followed by a smoke-cloud attack which necessitated the use of the extension filters, thus subjecting the troops to added labor in breathing, after days of constant use of the mask. The physical strain under such conditions can not fail to have been severe. It is not, however, to be supposed that the enemy was allowed to spend his time in full comfort.

As a means of detecting the approach of a toxic gas, canaries and white mice are placed in the trenches, as they are peculiarly sensitive to these chemicals and show signs of distress from dilutions which are unnoticed by man, especially when the gases are nearly odorless.

Of the offensive side of this gas-war it is obvious that little can properly be made public. There is reason to believe that our Amercan chemists are making valuable contributions in this field.—Henry P. Talbot in the *Atlantic Monthly*.

SCIENTIFIC BOOKS

Agricultural Bacteriology. By W. H. CONN. Third edition, revised by HAROLD JOEL CONN. Philadelphia, P. Blakiston's Son & Company. 1918. Pp. x + 357. Illustrated. with 63 figures. $2.00.

The first part of the book is taken up with a discussion of the general characters of microorganisms and their rôle in the decomposition of organic matter. The second part, which occupies practically one fourth of the volume, is devoted to the relations of bacteria to soil fertility. The cycles of carbon and nitrogen are presented. This section includes a chapter on 'The Manure Heap and Sewage" and on one "Bacteria in Water." In the latter the rôle of water in the distribution of disease-producing organisms is discussed. The third part presents the relation of bacteria to milk and to butter and cheese.

The use of microorganisms in industrial processes directly related to agriculture as in the manufacture of alcohol and of vinegar, the preparation of sauer kraut and silage, and in the retting of flax is discussed in the fourth part.

The fifth part includes a chapter on resistance against parasitic bacteria. Tuberculosis is discussed in some detail. Only fourteen pages are devoted to the other transmissible diseases of animals and fifteen pages to the parasitic diseases of plants.

The last part presents 39 laboratory exercises designed to supplement the text.

The second edition was marred by many mistakes, both in fact and statement. Many of these have not been corrected in the present edition. Errors in fact are illustrated by the statement that ordinary soils contain 0.1 to 0.2 per cent. of nitrate (p. 53); that H_2S may unite with water to form sulphuric acid (p. 78); that the sulphur appears within the cells of sulphur bacteria as minute reddish dots, and because of the color produced by the sulphur the bacteria are frequently called the "red bacteria" (p. 124). In fact the reddish color noted in some of the sulphur bacteria is not due to sulphur but to a pigment, purpurin. If the red color were due to sulphur, all bacteria that store sulphur would be red. Such is not the case.

It is stated that any product that contains much sugar is more likely to undergo alcoholic fermentation than putrefaction. A true statement as far as it goes, but likely to create confusion in the mind of the student, for a product containing much sugar practically never undergoes putrefaction and an alcoholic fermentation only when the product is so acid as to prevent bacterial development. In sugar containing liquids, the reaction of which will permit bacterial growth, an acid fermentation is constantly noted as in milk, maple sap, beet juice, etc.

The construction is often loose and in error, one part of a sentence being written in the present tense and another in the past, *e. g.*, "But the bacteria which are isolated from such soil by ordinary methods showed no power of nitrification" (p. 65). Errors in spelling are frequent, *e. g.*, volitization (p. 80), seradella (p. 112), urase (p. 60).

An example of the use of an incorrect word is found on page 63 where it is stated that "The addition of another atom of nitrogen to the nitrate, giving a nitrate," etc. The formulæ used in this connection are correct.

The reader of the present volume will find the essential facts concerning the relation of microorganisms to agricultural processes presented in a most interesting manner.

E. G. HASTINGS

UNIVERSITY OF WISCONSIN

BIRTH STATISTICS IN THE REGISTRATION AREA OF THE UNITED STATES: 1916

IN the recently established birth-registration area of the United States—comprising the six New England states, New York, Pennsylvania, Maryland, Michigan, Minnesota and the District of Columbia, with an estimated population of 33,000,000, or about 32 per cent. of the total population of the United States—818,983 infants were born alive in 1916, representing a birth rate of 24.8 per 1,000 of population. The total number of deaths in the same area was 486,682, or 14.7 per 1,000. The births thus exceeded the deaths by more than 68 per cent. For every state in the registration area, for practically all the cities, and for nearly all the countries, the births exceeded the deaths, usually by substantial proportions. The mortality rate for infants under one year of age averaged 101 per 1,000 living births. The foregoing are among the significant features of the report. "Birth Statistics in the Registration Area of the United States: 1916," soon to be issued by Director Sam. L. Rogers, of the Bureau of the Census Department of Commerce, and compiled under the supervision of Dr. William H. Davis, chief statistician for vital statistics.

The birth rate for the entire registration area fell below that for 1915 by one tenth of 1 per 1,000 population; while the death rate exceeded that for 1915 by seven tenths of 1 per

1,000. The excess of the birth rate over the death rate for 1916, 10.1 per 1,000, was thus a little less than the corresponding excess for 1915, which was 10.9 per 1,000. If the birth and death rates prevailing in the later year were to remain unchanged, and if no migration were to take place to or from the area to which they relate, its population would increase annually by about 1 per cent. This rate, compounded for a decade, would yield a decennial increase of a little more than 10 per cent., or about half the rate of increase in the population of the country as a whole between the last two censuses, 21 per cent.

Of the total number of births reported, 799,817, or 24.9 per 1,000, were of white infants, and 19,166, or 22.8 per 1,000, were of colored infants. The death rates for the two elements of the population were 14.5 and 24.4 per 1,000, respectively. The deaths reported for the colored races (comprising all nonwhites) thus exceeded the births reported; but it is probable that the registration of births is less nearly complete among the colored than among the white population, and that therefore the rate shown for the former class is too low, whereas in the case of death rates there is probably not so great a margin of error.

Some indication of the fecundity of the native and foreign elements of the population may be obtained from a comparison between the proportion which the number of white foreign-born mothers formed of the total number of white mothers to whom children were born in 1916, and the proportion which the white foreign-born married women, aged 15 to 44, formed of the total number of white married women of corresponding ages in 1910.

From the table following, it appears that many more births occur to white foreign-born women, proportionately to their number, than to native women. In Connecticut, approximately 46 per cent. of white married women aged 15 to 44 in 1910 were of foreign birth, but about 62 per cent. of the white mothers to whom children were born in 1916 were natives of foreign countries.

State	1916 Per Cent. which Foreign-born Mothers Formed of Total White Mothers	1910 Per Cent. which Foreign-born Married Females 15 to 44, Formed of Total White Married Females, 15 to 44
Connecticut	61.63	46.36
Maine	27.23	21.69
Maryland	14.82	13.11
Massachusetts	56.32	48.87
Michigan	32.80	26.45
Minnesota	26.80	33.99
New Hampshire	41.69	32.69
New York	52.84	42.71
Pennsylvania	37.65	27.77
Rhode Island	57.37	49.94
Vermont	24.04	18.11

The infant-mortality rate—that is, the number of deaths of infants under one year of age per 1,000 born alive—throughout the registration area as a whole was 101 in 1916, as against 100 in 1915. This is equivalent to saying that of every ten infants born alive one died before reaching the age of one year. Among the 11 states these rates ranged from 70 for Minnesota to 121 for Maryland; and for the white population separately the lowest and highest rates were 69 for Minnesota and 115 for New Hampshire. The high rate for the total population of Maryland was due to the presence of a larger colored element in that state than in any of the others, the rate for the whites alone being only 101.

The infant-mortality rates vary greatly for the two sexes and for the various nationalities.

With an infant-mortality rate of 101 for the registration area as a whole, the rate ranges for white children from 68 where mothers were born in Denmark, Norway and Sweden, to 148 where mothers were born in Poland, while negro children have a rate of 184. The range of rates among white males is from 74 for children of mothers born in Denmark, Norway and Sweden, to 171 for those of mothers born in Poland, while negro males have a rate of 202. The corresponding rates for females were 62, 124 and 166, respectively.

The following table shows, for the birth-registration area, by states and by cities having more than 100,000 inhabitants in 1910, the number of births in 1916, the per cent. of ex-

cess of births over deaths, and the infant-mortality rate. Figures for the white and colored elements of the population are shown separately for those areas in which colored persons constitute more than one tenth of the total population.

EXCESS OF BIRTHS OVER DEATHS, AND INFANT MORTALITY: 1916

Area	Number of Births	Excess of Births Over Deaths (Per Cent.)	Deaths of Infants Under 1 Year of Age per 1,000 Living Births
Registration area	818,983	68.7	101
Registration states			
Connecticut	35,351	74.2	101
Maine	16,033	32.5	108
Maryland, total:	33,631	49.7	121
White	27,305	63.9	101
Colored	6,326	6.0	209
Massachusetts	93,497	65.1	100
Michigan	86,840	88.1	96
Minnesota	55,459	127.1	70
New Hampshire	9,664	35.4	115
New York	241,456	58.8	94
Pennsylvania	217,449	74.7	114
Rhode Island	14,634	53.5	111
Vermont	7,768	37.2	93
Registration cities having more than 100,000 inhabitants in 1910			
Connecticut:			
Bridgeport	4,598	94.8	106
New Haven	5,106	100.6	88
Maryland:			
Baltimore, total	14,542	36.5	122
White	12,278	54.1	104
Colored	2,264	−16.6[1]	219
Massachusetts:			
Boston	19,577	53.3	105
Cambridge	2,691	76.3	91
Fall River	3,689	68.8	173
Lowell	3,287	67.6	146
Worcester	4,941	70.2	101
Michigan:			
Detroit	24,289	121.6	112
Grand Rapids	3,131	100.0	75
Minnesota:			
Minneapolis	8,793	95.2	82
St. Paul	5,242	87.6	68
New York:			
Albany	2,280	11.4	97
Buffalo	13,088	73.3	114
New York	137,923	77.0	93
Rochester	6,816	82.6	86
Syracuse	3,853	63.2	100
Pennsylvania:			
Philadelphia	40,360	45.7	105
Pittsburgh	16,406	62.6	115
Scranton	3,623	71.5	131
Rhode Island:			
Providence	5,981	48.7	110
District of Columbia:			
Washington, total	7,201	11.2	106
White	4,979	25.3	83
Colored	2,222	−12.2[1]	158

[1] Per cent. by which births fell below deaths.

SPECIAL ARTICLES

NOTE UPON THE HYDROGEN ION CONCENTRATION NECESSARY TO INHIBIT THE GROWTH OF FOUR WOOD-DESTROYING FUNGI[1]

THE importance of hydrogen (and hydroxyl) ion concentration as a factor in physico-chemical and biochemical studies of living organisms is being recognized. A careful study of this factor has not been made heretofore due largely to the lack of ready means for making the determinations. The indicator method was not seriously developed until about a decade or so ago, and the hydrogen electrode was not applied to such problems until recently, due partly, undoubtedly, to the fact that biologists did not realize its possibilities.

Consequently no exact information is at hand concerning the behavior of fungi, in general, toward varying degrees of hydrogen ion concentration. This remark applies especially to wood-destroying fungi. Information which is available is usually given in a rather vague manner with the use of such terms as "alkaline," "slightly acid," "strongly acid" or as percentage of acid (or base) added.

The expression, P , is now widely used as a means of stating hydrogen (or hydroxyl) ion concentration. The term is used and explained in the literature sufficiently often to make its explanation here unnecessary.

The four fungi studied in this investigation are: *Lenzite sepiaria, Fomes roseus, Coniophora cerebella* and *Merulius lachrymans*. Synthetic and malt extract media were used. The data obtained showed that their growth is not inhibited until a surprisingly

[1] This note is a brief statement of the results presented in a paper on the same subject in partial fulfillment of the requirements for the degree of Ph.D. at the New York State College of Forestry at Syracuse University. A considerable part of the work was done in the office of Forest Pathology, Bureau of Plant Industry, at the Forest Products Laboratory, Madison, Wis. Detailed data will be published soon.

high hydrogen ion concentration is reached, and furthermore, that these four organisms respond in about the same way, though there are distinct variations among them. Furthermore, as might be expected, the curves obtained are similar to those showing the relation between enzyme activity and hydrogen ion concentration.

The most important facts to be presented here can be shown by means of a general curve setting forth the general behavior of the four fungi studied. The curve shown in the accompanying figure is constructed by plotting as ordinates the weights in grams of mycelium, produced in about five weeks' time upon media of varying P_H values as represented by the abscissae. This curve shows in a very general way the mean of the individual curves for the different fungi when grown upon the two media. The weight of mycelium produced shows large variation among the individual curves while there is rather close agreement in the P_H values which are physiologically important to the various fungi.

In the following discussion we shall speak of the "first critical point," meaning the P_H at B (figure), the point where the first marked deflection in the growth curve appears; the "second critical point," meaning the P_H at C, where the second marked deflection in the opposite sense occurs in the growth curve; and the limiting acidity," meaning the P_H at D, where practically no growth occurs. By "critical range" we shall mean the range of the P_H values included between the first and the second critical points.

The curve in the accompanying figure is drawn with the portion AB horizontal. In the individual curves—that is for a single fungus on a single medium—this part may be horizontal or may slope either up or down in passing toward B. Or again, in passing from A toward B the curve may rise to a maximum and then fall toward the critical point B where a sharp inflection downward occurs. Such a maximum, when present, usually occurs nearer B than A—that is, at a P_H of about 3.0. The critical points stand out more sharply in some than in other curves and the first critical point is usually more pronounced than the second critical point. The slope between B and C shows a rather large variation in the

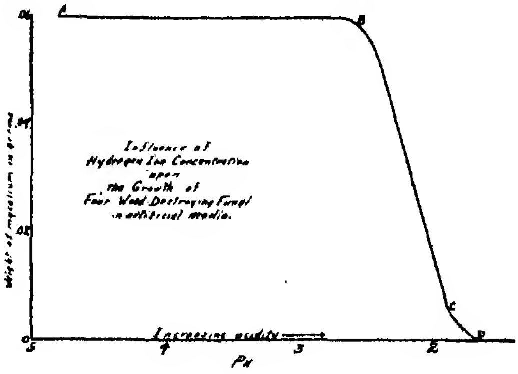


FIG. 1.

individual curves. In some cases the line between these two points is nearly vertical. In this curve the point D appears as a rather abrupt point. Point C often occurs nearer the lower axis and the portion of the curve CD occurs more nearly horizontal with a more or less uncertain termination. However, the limiting P_H value appears to be in the region of 1.7.

Translating these data into terms of normality, the first critical point occurs at about 1/350 normal, and the limiting acidity at about 1/50 normal, hydrogen ion concentration.

MERLE R. MEACHAM

THE NEW YORK STATE COLLEGE OF FORESTRY,
SYRACUSE UNIVERSITY

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

Friday, November 22, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE PHYSICAL CHEMISTRY OF BREAD MAKING[1]

The art of making leavened bread has been so long perfected that the experience upon which present practise rests is now forgotten. Meanwhile the science of bread making, involving physical, chemical and physiological problems of a certain complexity, and only recently promoted by a great organized industry, has hardly kept pace with the advance of biological chemistry. But at length war time necessity has imposed new conditions, and the use of flours other than wheat has brought about changes from the best practise of the past.

It seems desirable, therefore, to review the physical and chemical processes involved in the fermentation of dough and the baking of bread, and make suggestions which may facilitate the use of wheat substitutes.

GLUTEN

When wheat flour is made into dough the proteins, after absorbing water, hold together to a much greater extent than do the proteins of any other grain. This property makes it possible to separate from the other constitutents of wheat flour the two proteins, gliadin and glutenin,[2] which are insoluble in water. The material which can in this way be washed free contains about ten per cent. of the flour[3] and includes about nine tenths of all the protein material.[4] It is called gluten.

1 From the Wolcott Gibbs Memorial Laboratory of Harvard University, in collaboration with the Division of Food and Nutrition, Medical Department, U. S. Army.

2 Osborn, T. B., "The Proteins of the Wheat Kernel." Washington, 1907.

3 Bulletin 13, part 9, Division of Chemistry, United States Department of Agriculture.

4 Jago, William, "Science and Art of Bread-making," pp. 288–303, London, 1895.

Proteins, unlike starches, combine with acids and alkalis. Such combinations differ in their properties according to the quantity of acid or alkali which they contain. Similar differences are also produced in the properties of proteins by the action of salts. Among the most important of the effects of acids, alkalis and salts upon proteins is the modification of the swelling in water, and partly as a result of this, of elasticity, tenacity and cohesiveness. Another important effect is a change in the solubility of the proteins.

As the amount of acid or alkali combined with gluten varies, the amount of water which can be absorbed varies from 2½ to 3½ times the weight of the gluten itself.[5, 6, 7] Certain salts also have an important effect upon the swelling of gluten.[8]

In spite of the fact that such phenomena are more or less similar to those which may be observed with other proteins, there are many properties of gluten which are very different from those of other known protein substances. The unique properties of gluten make possible the manufacture of good leavened bread.

DOUGH

The swollen, coherent gluten imparts to wheat-flour dough the properties of tenacity and elasticity that are peculiar to it. It permits the stretching and distending of the mass in bread-making. As a result the volume may increase four or five fold. Dough made from other grains, even though containing more protein and possessing a greater capacity to absorb water, is both less elastic and less coherent. When stretched such doughs break. The baker calls them "short."

The extent to which dough can be distended varies with the quantity and with the physical condition of the gluten. Within certain limits the baker can therefore improve the rising of dough by modifying the physical condition of gluten. Thus, for instance, increasing the acidity of dough will increase its elasticity[9] and certain salts, such as calcium sulphate, may have a similar effect.

THE FERMENTATION OF SUGAR

Bread is leavened by the formation of carbon dioxide within the dough through the fermentation of sugar by yeast. Yeast can freely utilize either cane sugar or glucose for the production of carbon dioxide. In American baking practise, where a short fermentation is usually preferred, sugar is therefore added to dough. The proper amount of sugar depends upon the conditions of the fermentation. It is, however, as the present practise of certain nations and the early history of baking prove, not necessary to add any sugar at all, for a small amount of sugar is present in flour,[10, 11] and more is slowly produced from starch during fermentation by the action of enzymes. But sugar can not be left out unless the whole practise of the baker differs from that now followed in America.

THE PRODUCTION OF CARBON DIOXIDE BY YEAST

Yeast is very sensitive to slight changes in the dough batch. For instance, activity at 30° C. (86° F.) is about twice as great as 20° C. (68° F). The production of carbon dioxide is, however, much decreased by the large quantity of salt which is added to the dough with the water, sugar and shortening. By means of this effect of salt on the activity of yeast the baker commonly controls the

5 Wood, T. B., "The Chemistry of Strength of Wheat Flour," *Jour. Agricultural Science*, Vol. 2, Part 3, pp. 267–277, 1907.

6 Wood, T. B., and Hardy, W. B., "Electrolytes and Colloids: The Physical State of Gluten," *Proceedings Roy. Soc. B*, LXXI., pp. 31–43, 1909.

7 Unpublished observations.

8 Wood, T. B., "The Chemistry of Strength of Wheat Flour," *Jour. Agricultural Science*, Vol. 2, Part 2, pp. 139–160, 1907.

9 Henderson, L. J., Fenn, W. O., Cohn, E. J., "The Influence of Electrolytes upon the Viscosity of Dough" *Journal of General Physiology*.

10 Wood, T. B., "The Chemistry of Strength of Wheat Flour," *Jour. Agricultural Science*, Vol. 2, Part 2, pp. 267–277, 1907.

11 Maurizio, *Landwirtschaftliche Jahrbücher*, XXXI., 1902.

length of fermentation. Another method is to vary the quantity of yeast.

But the rate of carbon dioxide production by yeast is also greatly influenced by the products of its own activity. During fermentation there is a continual increase in the acidity of dough and as a result, up to a certain point (reached only in very old and very acid dough), the activity of the yeast steadily becomes greater. The activity of the yeast will, nevertheless, diminish when the supply of sugar is no longer sufficient.

THE PRODUCTION OF ACID BY YEAST

The increasing acidity of dough both improves the condition of the dough and increases the production of carbon dioxide by the yeast. Accordingly, the dough rises more and more rapidly as the fermentation progresses.

The baker usually prolongs fermentation by "knocking down" the dough. By thus prolonging the process the products of the fermentation and the acidity of the dough are increased and therefore the volume of the dough, when it rises again, is greater.

THE ADDITION OF ACID TO DOUGH

The addition of such weak acids as lactic or acetic acid (vinegar) to dough has much the same effect. The amount of acid that may be added will vary with the amount of yeast and the length of fermentation. It can best be judged by determining the acidity of the baked loaf.[12] This can be done by judging the color when a few drops of methyl red are added to a slice of bread. The amount of acid which can favorably be added in ordinary bread making is discussed below in connection with the prevention of rope. It must be remembered that the desirable amount of acid varies with the quantity of yeast, with the quality of the wheat flour, with the quantity and variety of substitute and with the habits of the baker.

In the first place the desirable length of the fermentation is determined by the acidity of the dough. Increase in acidity increases the activity of the yeast and shortens the fermentation. Consequently the amount of sugar required by the yeast is diminished.[13] Beside the rate of carbon dioxide production of the yeast within the dough, the tenacity and elasticity of the dough, and the escape of gas from the dough are dependent upon acidity. Experience in this and other laboratories has shown that the best acidity for the baking of bread is indicated by the turning of methyl red from orange to red.[14, 15, 16] *In sum, the acidity of the dough at the time of baking seems to be the most important variable factor in bread making.*

THE ESCAPE OF GAS FROM THE DOUGH

The volume of the baked loaf is not completely determined by the volume of the risen dough. For not all of the carbon dioxide produced is retained within the dough: a large part escapes into the air. As a dough expands more and more the loss of gas increases, because the surface of a distended dough becomes greater, while the walls of the batch grow thin and more leaky. When, during the last rise, loss of gas from the dough becomes nearly as great as the production of carbon dioxide, the loaf *must* be baked regardless of its size. But the more tenacious and elastic the dough, the larger will be its volume before the losses from the batch reach this point. The "age" or "ripeness" of the dough is always best determined by the baker who through long practise has learned to judge it accurately.

BAKING

It has been suggested that dough must be baked before the loss of gas is equal to the

12 Henderson, L. J., "The Prevention of Rope in Bread," SCIENCE, N. S., Vol. 48, No. 1236, pp. 247–248, 1918.

13 Unpublished observations.

14 Cohn, E. J., Cathcart, P. H., and Henderson, L. J., "The Measurement of the Acidity of Bread," *Jour. Biological Chemistry*, 1918.

15 Jessen-Hansen, *Comptes Rendus Trav. Lab. Carlsberg*, Vol. 5, No. 10, 1911.

16 Landenberger, L. L., "Barley Bread Optimum Reaction and Salt Effect," SCIENCE, N. S., Vol. 48, No. 1237, pp. 269–270, 1918.

production of carbon dioxide, or, in other words, before the rise ceases. Such doughs are "ripe" for the oven. The baker says their "proof" is complete.

The less elastic and tenacious doughs of the present emergency have little "spring" in the oven and if ripe are very liable to fall during the early stages of the baking. To guard against this it is a common practise to shorten the fermentation, which involves baking at a lower acidity.

"Overproved" doughs usually fall in the oven before the crust is formed by drying and coagulation of the proteins of the dough. In them the loss of carbon dioxide is not even compensated by the expansion of the gas at the higher temperature of the oven. Doughs that are not "ripe" for the oven are in the opposite condition and are termed "underproved." The leakage of carbon dioxide from such doughs is not sufficient to permit the escape of the expanded gas and the loaf is "ripped."

WHEAT SUBSTITUTES

Although corn, barley and wheat flour contain nearly equal amounts of similar proteins, the properties of their doughs are markedly different. Rye is more tenacious than barley, and barley than corn, but in comparison with doughs made of wheat flour all others are "short." They do not hold together and are not distensible. Therefore—with the possible exception of rye—they can not retain the carbon dioxide that is produced within them. To whatever extent such flours are substituted for wheat the same effects are observed in due proportion. For the "body" of the dough is supplied by the wheat gluten alone. The degree to which the dough can be distended therefore depends upon the amount and the hydration of the gluten. But in the presence of substitutes the hydration of gluten is complicated in two ways: first because water is absorbed by the proteins of corn and of barley as well as by the proteins of wheat, but nevertheless without the resulting elasticity;[17] secondly because corn and barley combine with larger quantities of acid than does wheat.[18] The increasing acidity of the fermenting dough is thus partially neutralized. As a result neither the activity of the yeast nor the elasticity of the dough increases so rapidly in the presence of substitutes. If the smaller amount of gluten that is present is to swell to the same extent as in ordinary bread the same acidity must be reached. Therefore if the amount of yeast or the length of the fermentation is not to be increased, acid must be added to the dough.

But if the volume of the loaf is in this way increased, other dangers beset the baker when using a high percentage of substitute flours, for the leakage of carbon dioxide from the dough is also increased. As above mentioned the dough has little "spring" and falls more easily in the oven. This is another reason why the cautious baker has made his bread less acid during war time. He prefers baking dough that is "younger." The frequent occurrence of "ripped" bread is in this way accounted for.

Moreover, the popularity of starch in the larger bake shops of the country during the last year, and the facility with which it was used, depend upon the fact that unlike all flours, starch absorbs only about half its weight of water and combines with acid to an inappreciable extent.

SERUM PROTEINS

Although skillful control of the fermentation and of the acidity of dough (and sometimes the addition of salts like calcium sulphate) can improve leavened bread of any kind, it can not make up for the lack of gluten in wheat substitutes. Therefore, when wheat substitutes are employed it is desirable to add a small amount of a substitute for gluten.

The proteins of serum are such a substitute. The addition to flour containing 20 to 25 per cent. wheat substitutes of two or three per cent. of dry powdered serum (which must be

[17] Unpublished observations.

[18] Unpublished observations.

freely soluble)[19] yields a dough quite as easy to handle as that produced from pure wheat flour. Such a dough does not, like ordinary doughs containing substitutes, easily become "overproved." The loaves do not fall in the oven, for the serum proteins decrease the leakage of carbon dioxide from the dough.[20] The danger of the loss of a whole batch from excessive fermentation is therefore minimized.

The use of serum proteins in this way materially lessens the very real difficulties which now exist. Moreover the resulting loaf is larger and more elastic, of better color and texture, and in all respects superior to loaves containing equal amounts of wheat substitutes but lacking serum. If it is inferior to bread made of pure wheat flour, it possesses certain important qualities of its own, and its use seems to be in all respects quite unexceptionable.

ROPE

Ropy bread is produced by the action of certain microorganisms whose spores survive the heat of the oven and later, when the conditions are favorable, attack the center of the loaf. At a temperature of about 26° C. (80° F.) their growth is rapid. For this reason epidemics of rope occur in summer. The principle organisms which cause rope belong to the *B. mesentericus* group.

Another condition which is necessary for the development of the rope organism is low acidity.[21] Bread which is sufficiently acid is quite immune. It is therefore possible absolutely to prevent rope by sufficiently increasing the acidity of dough. It has been found that the degree of acidity which is otherwise most favorable in ordinary bread making, at least as practised both in America[14, 16] and in Denmark[15] is sufficient for this purpose. This acidity is indicated by a full red color when a few drops of a solution (0.02 per cent. in 60 per cent. alcohol) of the indicator methyl red are placed upon a slice of bread. Bread should be adjusted to this acidity, especially when there is danger of an epidemic of rope. This is best done by the addition of increasing amounts of acid to the dough of successive batches until the baked loaf gives the desired color. Generally the right amount of lactic acid is between one and two pounds of the commercial product (22 per cent.–25 per cent.) per barrel of flour. (This corresponds to 1.25 c.c. normal lactic acid in 100 g. flour.)

It has been pointed out that wheat substitutes usually combine with more acid than wheat flour itself. In this way they neutralize the acidity of the dough and as a result the greater the amount of substitute the greater is the amount of acid that must be added to bring bread to the acidity indicated by a red color of methyl red. The preference of the baker for "young" doughs and the greater capacity of the substitutes to neutralize acids is the reason why rope has caused so much trouble during war time.

We are indebted to the Carnegie Institution of Washington and to Professor Theodore W. Richards for the use of much valuable and indispensable apparatus, without which our researches could hardly have been carried out. It is a great pleasure to express our thanks for this aid.

E. J. COHN,
L. J. HENDERSON

19 Burrows, G. H., and Cohn, E. J., "A Quantitative Study of the Evaporation of Serum Proteins," *Jour. Biological Chemistry*, 1918.

20 Unpublished observations.

21 Cohn, E. J., Wolbach, S. B., and Henderson, L. J., "The Control of Rope," *Jour. of General Physiology*, Vol. 1, No. 2, 1918.

INDUSTRIAL RESEARCH AND NATIONAL WELFARE[1]

AT the outbreak of the war the average statesman of the Allied powers was but little concerned with the interest of research. Necessity, however, soon opened his eyes. He began to perceive the enormous advantages derived by Germany from the utilization of sci-

1 From an address delivered by Dr. George E. Hale under the auspices of Engineering Foundation in the Engineering Societies Building, New York, May 28, 1918.

ence, and sought to offset them by the creation of appropriate agencies. Thus arose throughout the British Empire a group of councils for scientific and industrial research. The first of these was established in England by an order in council issued in 1915. Subsequently, Canada, Australia and South Africa followed the example of the mother country, and New Zealand proposes to do likewise. The world-wide movement swept across the empire, and its benefits will be felt in every country under the British flag. A similar awakening was experienced in France and Italy, but in both of these countries the pressure of the war concentrated attention for the moment upon military problems. At present, the needs of industry are also under consideration, and research organizations are being developed to meet them.

Without entering here into a detailed discussion of these councils, we may mention certain typical illustrations of their activities from the report of the British Advisory Council for Scientific and Industrial Research for the year 1916–17. In this period it devoted itself mainly to the organization of industrial research, partly because of the prime importance of stimulating and fixing the interest of manufacture in the development of industry through research, and partly because the effect of the war has been to render industrial leaders more susceptible than ever before to the growth of new ideas. In pure science, on the contrary, the war has seriously affected the prosecution of research, because so many investigators have been drawn into military and industrial activities. Thus, while the advisory council strongly emphasizes the fundamental importance of pure science, it has been forced to postpone its activities in this field until the arrival of more favorable conditions.

Research for the development of the industries may be conducted in several different ways. In this country a stimulating example has been set by such great corporations as the American Telephone and Telegraph Company, the General Electric Company, the Eastman Kodak Company, the Dupont Companies, and the Westinghouse Electric Company, which have established large research laboratories.

The value of this example has been enhanced by the remarkable success achieved by these laboratories in matters affecting public welfare, such as the reduction in cost of electric lighting caused by the development of the Mazda lamp and the possibility of transcontinental telephony, not to mention the latest advances in the field of wireless telephony.

Self-interest will sooner or later induce many other corporations to adopt similar methods of improving their products, but the heavy expense of establishing independent research laboratories will sometimes prove an insurmountable obstacle. Other means must then be resorted to. A useful example is that afforded by the National Canners' Association, which has established a central research laboratory in Washington, where any member of the association can send his problems for solution and where extensive investigations, the results of which are important to the entire industry, are also conducted.

The British Advisory Council, aided by a government appropriation of one million pounds, is actively promoting the organization of trade research associations for the mutual benefit of the members of the great industries. Thus a provisional committee representative of the British cotton industry has proposed the establishment of a cooperative association for research in cotton, to include in its membership cotton spinning, doubling the thread making firms, cloth, lace and hosiery manufacturers, bleachers, dyers, printers and finishers, which will conduct researches extending from the study of the cotton plant to the "finishing" of the manufactured article. So long ago as 1835 Baine wrote in his "History of the Cotton Manufacture": "The manufactory, the laboratory and the study of the natural philosopher, are in close practical conjunction; without the aid of science, the arts would be contemptible; without practical application, science would consist only of barren theories, which men

would have no motive to pursue." This spirit, clearly shown in the early cotton industry, is now to be revived for the common benefit.

The woolen and worsted manufacturers of Great Britain are also drafting the constitution of a research association, and the Irish flax spinners and weavers are about to do likewise. Research associations will be established by the Scottish shale oil industry and the photographic manufacturers, while various other British industries are looking in the same direction. Thus a national movement for research, directly resulting from the war, has already made marked headway. The research councils in various parts of the British Empire, actuated by the same spirit, are rapidly extending the advantages which an appreciation of the national importance of research will afford.

The National Research Council, aided and supported by the Engineering Foundation, is just entering upon an extensive campaign for the promotion of industrial research. In addition to a strong active committee, comprising the heads of leading industrial laboratories and others prominently identified with scientific methods of developing American industries, an advisory committee has been formed to back the movement. This already comprises the following gentlemen: Honorable Elihu Root; Mr. Theodore N. Vail, president of the American Telephone and Telegraph Company; Dr. Henry S. Pritchett, president of the Carnegie Foundation for the Advancement of Teaching; Mr. Edwin Wilbur Rice, Jr., president of the General Electric Company; Mr. George Eastman, president of the Eastman Kodak Company; Mr. Pierre S. duPont, president of the E. I. duPont de Nemours Powder Company; Mr. A. W. Mellon, founder of the Mellon Institute for Industrial Research; Judge E. H. Gary, president of the United States Steel Corporation; Mr. Cleveland H. Dodge, of the Phelps-Dodge Corporation, and Mr. Ambrose Swasey, of The Warner and Swasey Company.

We are indeed fortunate to have the aid of men whose experience and standing are so certain to command public recognition of the claims of scientific and industrial research.

Science is in the air, keen competition is in prospect, and the industries are more favorably inclined than ever before to the widespread use of research methods. Their greatest leaders, moreover, are unanimous in their appreciation of the necessity of promoting research for the sake of advancing knowledge, as well as for immediate commercial advantages. Only thus can the most fundamental and unexpected advances be rendered possible, and continued progress in all directions assured.

GEORGE SCHRADER MATHERS

CAPTAIN GEORGE SCHRADER MATHERS, M.C., U. S. Army, a member of the staff of the McCormick Institute for Infectious Diseases, Chicago, died October 5, 1918, at the age of thirty-one.

Captain Mathers took his college work in the University of Texas and the University of Chicago, and received his medical degree from Rush Medical College in affiliation with the University of Chicago in 1913. Having served one year and one half as interne in the Cook County Hospital he began work in the McCormick Institute under a grant from the Fenger Memorial Fund, but before long he became associated fully with the institute. During the three and one half years of this association he accomplished much fruitful work and published important papers or lobar pneumonia, epidemic poliomyelitis, acute respiratory infections in man and in the horse, and on epidemic meningitis. He demonstrated that a streptococcus-like microorganism occurs apparently constantly in the central nervous system in persons that have died from epidemic poliomyelitis. Early last spring he was commissioned as first lieutenant and placed in charge of the laboratory of the embarkation hospital at Camp Stuart. In May he was promoted to captain and given charge of the laboratory of the base hospital at Camp Meade. He gave himself completely to his work. In the course of his duties and while intensely

engaged in a study of the bacteriology of influenza he was stricken and died with pneumonia in a few days.

Captain Mathers was a fine, lofty-minded, lovable young man, of rare enthusiasm for work, and a remarkable efficiency. He had committed himself to research and his early death is a great loss to medicine.

Ludvig Hektoen

ARTEMAS MARTIN

Dr. Artemas Martin, of the U. S. Coast and Geodetic Survey, died on November 7, 1918, after an illness of two weeks, in the eight-fourth year of his life. He was born on a farm in Steuben County, New York, on August 3, 1835. Four winters in the schools of Venango County, Pennsylvania, comprised all his schooling. Wood-chopping, oil-well drilling and farming—with four winters as a district teacher—made up his work until the age of fifty. The little leisure afforded by such work was devoted to the study of mathematics.

Early in life he began contributing problems and solutions to various magazines. In 1877, while engaged in market gardening for a livelihood, he began the editing and publishing of the *Mathematical Visitor* and in 1882 he followed this up with the *Mathematical Magazine*. Not only did he do the editing and publishing of these magazines, but for financial reasons was compelled to do the type setting also. That he did this well is evidenced by the character of the mathematical typography of his journals.

Aside from articles in his own magazines, he contributed a large number of papers to various mathematical journals here and abroad. His writings dealt chiefly with properties of triangles, logarithums, properties of numbers, diophantine analysis, probability and elliptic integrals. He was an authority on early mathematical text-books and collaborated with Dr. Greenwood in the "Notes on the History of American Text-Books on Arithmetic."

Dr. Martin's mathematical abilities received wide recognition. In 1877, Yale conferred upon him the honorary degree of A.M., Rutgers honored him with a Ph.D., in 1882, and in 1885 Hillsdale made him an LL.D. Numerous learned societies, both here and abroad, honored him with membership.

In 1885, Dr. Martin was appointed librarian of the U. S. Coast and Geodetic Survey, where his wide knowledge of mathematics made him of great service. In 1898 he was made computer in the Division of Tides, which place he held until his death.

Personally, he was a man of very prepossessing appearance. Of simple tastes and exhibiting few of the limitations of the pioneer period through which he passed the first fifty years of his life, he exemplified most of its robust virtues. Fond of home life and children he denied himself marriage that he might care for his parents and sisters. Traveling scarcely at all, he was well known to American mathematicians of the previous generation who found him an agreeable and companionable man.

Dr. Martin's memory is to be fittingly perpetuated in the Artemas Martin Library of the American University at Washington, D. C. This library, consisting principally of mathematical works, and given by Dr. Martin to the American University shortly before his death, was considered one of the finest private collections in America. At the same university there is also to be an Artemas Martin Lectureship in mathematics and physics, endowed by Dr. Martin.

SCIENTIFIC EVENTS

THE BEQUESTS OF MRS. SAGE

The will of Mrs. Margaret Olivia Sage, disposes of an estate estimated at \$50,000,000, of which more than \$40,000,000 is to be distributed among charitable, educational and religious institutions. It is said that since the death of her husband, Mrs. Sage had given between \$35,000,000 and \$40,000,000 to various institutions and charities, using part of the principal, as well as the income, of the Sage estate in these benefactions.

The estate is divided into fifty-two equal parts for convenience in distributing the residue among the various charities named in the instrument. Each of these parts is valued at approximately $800,000.

The will contains the following clause relating to these legacies: "It is my desire that each religious, educational and charitable corporation, which may receive a share of my residuary estate shall use the whole or part of such legacy received by it for some purpose which will commemorate the name of my husband, but I simply express this as a desire and do not impose it as a condition on my gift." Certain sums given by Mrs. Sage in her lifetime to institutions and organizations are to be deducted from the amounts to be distributed from the residue, which is to be divided as follows:

Russell Sage Foundation, $5,600,000; Troy Female Seminary, Woman's Hospital in the state of New York, Board of Home Missions of the Presbyterian Church of America (woman's executive committee), Woman's Board of Foreign Missions of the Presbyterian Church, New York City Mission and Tract Society, American Bible Society, Children's Aid Society, Charity Organization Society, $1,600,000; Presbyterian Board of Relief for Disabled Ministers, $800,000; Metropolitan Museum of Art and The American Museum of Natural History, $1,600,000 each; New York Botanical Garden, New York Zoological Society, New York Public Library, Troy Polytechnic Institute, Union College, Schenectady, $800,000 each; Syracuse University, $1,600,000; Hamilton College, Clinton, N. Y., New York University, Yale University, Amherst College, Williams College, Dartmouth College, Princeton University, Barnard College, Bryn Mawr College, Vassar College, Smith College, Wellesley College, Tuskegee Normal and Industrial Institute, New York Infirmary for Women and Children, Presbyterian Hospital in the City of New York, State Charities Aid Association and Hampton Institute, $800,000 each.

The will then gives the following specific legacies to public institutions:

Troy Female Seminary, $50,000; Association for the Relief of Respectable Aged Indigent Females in the City of New York, $125,000; Woman's Hospital in the State of New York, $50,000; Board of Home Missions of the Presbyterian Church of the United States of America (Woman's Executive Committee of Home Missions), $25,000; Woman's Board of Foreign Missions of the Presbyterian Church, $25,000; New York City Mission and Tract Society (Woman's Board), $20,000; New York Female Auxiliary Bible Society, $10,000; Children's Aid Society of the City of New York, $10,000; Charity Organization Society of the City of New York, $20,000; First Presbyterian Church of Syracuse, $10,000; First Presbyterian Church at Sag Harbor, $10,000; Society for the Relief of Half Orphan and Destitute Children of the City of New York, $25,000; New York Institution for the Deaf and Dumb, $25,000; Home for the Friendless, $100,000; New York Exchange for Women's Work, $25,000; Woman's National Sabbath Alliance, $25,000; Ladies' Christian Union of the City of New York, $100,000; Working Women's Protective Union, $10,000; Servants of Relief for Incurable Cancer, $25,000; Salvation Army, $25,000; Park College, $100,000; Idaho Industrial Institute, $200,000; Old Ladies' Home at Syracuse, $25,000; Northfield Schools (Northfield Seminary and Mount Hermon Boys' School), $100,000; Middlebury College, $100,000; Rutgers College, $100,000; Y. M. C. A. of the City of New York, $100,000; Y. W. C. A. of the City of New York, $100,000; Mount Sinai Hospital, $100,000; Syracuse University, $100,000; Hampton Institute, $100,000.

INTERNATIONAL SCIENTIFIC ORGANIZATION

The following statement has been adopted unanimously by the Inter-Allied Conference on the future of International Organization in Science, which met at Burlington House under the auspices of the Royal Society on October 9. It is intended to serve as a preamble to a number of resolutions, dealing with the withdrawal of the Allied nations from existing international associations and the formation of new ones to take their place. The confirmation of the academies represented at the Conference is required before the text of the resolutions can be made public:

When more than four years ago the outbreak of war divided Europe into hostile camps, men of science were still able to hope that the conclusion of peace would join at once the broken threads; and that the present enemies might then once more be able to meet in friendly conference, uniting their efforts to advance the interests of science. For ever since the revival of learning in the Middle Ages, the

prosecution of knowledge has formed a bond strong enough to resist the strain of national antagonism. And this bond was strengthened during the latter part of the last century, when branches of science developed requiring for their study the cooperation of all the civilized nations of the world. International associations and conferences rapidly multiplied, and the friendly intercourse between the learned representatives of different countries grew more intimate, in spite of their political differences, which were admitted but not insisted upon.

In former times, war frequently interrupted the cooperation of individuals without destroying the mutual esteem based on the recognition of intellectual achievements; peace then soon effaced the scars of a strife that was ended. If to-day the representatives of the scientific academies of the Allied nations are forced to declare that they will not be able to resume personal relations in scientific matters with their enemies until the Central Powers can be readmitted into the concert of civilized nations, they do so with a full sense of responsibility; and they feel bound to record the reasons which have led them to this decision.

Civilization has imposed restrictions on the conduct of nations which are intended to serve the interests of humanity and to maintain a high standard of honor. Such are the recognition of the sanctity of treaties—especially those designed to apply to a state of war—and the avoidance of unnecessary cruelties inflicted on civilians. In both these respects the Central Powers have broken the ordinances of civilization, disregarding all conventions and unbridling the worst passions which the ferocity of war engenders. War is necessarily full of cruelties: individual acts of barbarity can not be avoided and have to be borne. It is not of these we speak, but of the organized horrors encouraged and initiated from above with the sole object of terrorizing unoffending communities. The wanton destruction of property, the murders and outrages on land and sea, the sinking of hospital ships, the insults and tortures inflicted on prisoners of war, have left a stain on the history of the guilty nations which can not be removed by mere compensation of the material damage inflicted. In order to restore the confidence, without which no scientific intercourse can be fruitful, the Central Powers must renounce the political methods which have led to the atrocities that have shocked the civilized world.

The following delegates were expected to attend the Conference, representing different nations and academies:

Belgium.—Major Lecomte, director of the Royal Observatory of Belgium; M. Massart, professor of botany at the University of Brussels; Professeur de la Vallée Poussin.

France.—B. Baillaud, director of the Observatory of Paris; G. Bigourdan, astronomer at the Observatory of Paris; A. Haller, professor of organic chemistry at the Sorbonne; M. Lacroix, secretary of the Académie des Sciences, professor of mineralogy at the Sorbonne; Ch. Lallemand, director of the Trigonometrical Survey; Ch. Monreu, professor of pharmaceutical chemistry at the Ecole Supérieure; Emile Picard, secretary of the Académie des Sciences, professor of mathematics at the Sorbonne.

Italy.—Vito Volterra, professor of mathematical physics at the University of Rome, member of the Italian Senate.

Japan.—Joji Sakurai, professor of chemistry at the University of Tokyo; Aikitsu Tanakadate, late professor of physics at the University of Tokyo.

Portugal.—Professor Braamkamp Freire, president of the Academy of Science, Lisbon.

Serbia.—Bogdan Popovitch, professor of literature and rhetoric at the University of Belgrade; Dr. Zonjovitch, president of the Royal Academy of Belgrade.

United States.—H. A. Bumstead, professor of physics at Yale University; Colonel J. J. Carty, chief engineer of the American Telegraph and Telephone Company; W. J. Durand, professor of mechanical engineering at Stanford University; S. Flexner, director of the Rockefeller Institute; G. E. Hale, director of the Mount Wilson Observatory, A. A. Noyes, professor of chemistry at the Massachusetts Institute of Technology.

THE HARVEY SOCIETY

At a meeting of the Harvey Society held during September the following officers were elected:

President—Dr. Graham Lusk.
Vice-president—Dr. Rufus Cole.
Secretary—Dr. Karl M. Vogel.
Treasurer—Dr. F. H. Pike.
Other members of the Council—Dr. John Auer, Dr. James W. Jobling, Dr. Frederic S. Lee.

It was decided at this meeting that the number of lectures to be given during the winter of 1918–19 should not exceed six; that the lectures of last winter and this winter be incorporated together in one volume; and that the members of the society be charged dues

for one year only to cover the two years of activity. Following the policy of a year ago, the lectures to be given during this season are to be related to problems of the war.

The first lecture has already been given by Dr. E. K. Dunham. Two lectures which were arranged to be held, one by Dr. Stewart Paton on the "Psychology of the Aviator"; the other by Dr. Alonzo Taylor on the "World's Food Situation," have been postponed on account of the departure of these men for Europe. Lectures, however, have been provisionally arranged as follows:

January 11, Colonel Eugene R. Whitemore, "Infectious Diseases in the Army."

January 25, Dr. R. M. Yerkes, "Psychological Examination of the Soldier."

February 8, Dr. Yandell Henderson, "Physiology of the Aviator."

March 1, Dr. Frederic S. Lee, "Industrial Fatigue."

March 15, Colonel F. P. Underhill, "War Gases."

THE AMERICAN SOCIETY OF NATURALISTS

The American Society of Naturalists, in affiliation with the Botanical Society of America and the American Society of Zoologists, will hold its thirty-sixth annual meeting at Baltimore, under the auspices of Johns Hopkins University, on Saturday, December 28, 1918.

The Botanical Society of America will place the genetical papers of its program on Friday morning, December 27, and the American Society of Zoologists will group its genetical papers in a program for Friday afternoon. By this arrangement there will be sessions of interest to the members of the American Society of Naturalists on the day preceding the meetings of the society.

The American Society of Naturalists will offer, beginning Saturday morning, December 28, a program to which members of the society are invited to contribute papers.

The customary symposium of the Naturalists will this year be omitted. Well developed plans of the program committee were disarranged by conditions of the times at a date too late for readjustments.

The Naturalists' dinner, in which members of the affiliated societies are invited to participate, will be held on the evening of Saturday. At the close of the dinner Vernon L. Kellogg will talk on "The German philosophy of war."

Titles of papers offered by members of the society, with estimated length of delivery and statement of lantern or chart requirements, must be in the hands of the secretary by December 1. It is desired that papers be short and it should be remembered that the interests of the Naturalists are primarily on problems of organic evolution. The papers on the program will in general be arranged in order of the receipt of title except that papers on similar subjects may be grouped.

Attention is called to the change in the constitution by which a nomination for membership must now remain in the hands of the executive committee for at least one year before action can be taken upon it. Therefore, nominations to receive attention in 1919 must reach the secretary by December 31, 1918. Blank forms for nominations may be obtained from the Secretary.

Headquarters of the Naturalists will be at the Hotel Rennert, Liberty and Saratoga Streets. Members are advised to make early reservations. A list of boarding houses will be found at Registration Headquarters of the American Association for the Advancement of Science

Bradley M. Davis,
Secretary

Statistical Division,
Food Administration,
Washington, D. C.

THE BALTIMORE MEETINGS OF SECTION F (ZOOLOGY) OF THE AMERICAN ASSOCIATION

The coming meetings of Section F of the American Association for the Advancement of Science will be held at Baltimore in connection with those of the American Society of Zoologists on December 26, 27 and 28.

The address of Professor Herbert Osborn, of Ohio State University, the retiring vice-president, will probably be given Thursday afternoon, on the subject of zoological trends and values in relation to education.

A conference has been arranged between government and laboratory zoologists for the purpose of securing closer cooperation between the two groups. The Bureaus of Entomology, Fisheries, Animal Industry and the Biological Survey will present papers giving their needs and plans that can be furthered by such cooperation. The discussion will be led by Professors C. A. Kofoid, C. E. McClung, J. G. Needham and H. B. Ward. Through the kindness of the American Naturalists this conference will be held on Saturday afternoon, December 28.

The Headquarters hotel for Section F will be the Hotel Rennert, Liberty and Saratoga Streets. The association is preparing a list of boarding and rooming houses. This list may be consulted at registration headquarters.

The Biologists' smoker will be held following the opening exercises of the association on the evening of December 26, in the Hotel Rennert. The Naturalists' dinner is on Saturday evening.

As usual when meeting with the American Society of Zoologists, the program is in the hands of the latter society. Papers accompanied by abstracts of not more than 250 words will be accepted for the program up to December 1 as in other years. *These should not be sent to Captain Caswell Grave but to the acting secretary.*

W. C. Allee,
Acting Secretary, Section F,
Acting Secretary, American Society of Zoologists

Lake Forest College,
Lake Forest, Illinois

SCIENTIFIC NOTES AND NEWS

Dr. Charles R. Van Hise, president of the University of Wisconsin and eminent as a geologist, died on November 19, at the age of sixty-one years.

At the request of the board of regents of the University of Nebraska, the War Department has permitted Major Samuel Avery, chief of the University Relations Branch, Chemical Warfare Service, to resign his commission, in order to resume his duties as chancellor of the university, on December 1. Major Victor Lenher, in addition to his other duties in the Relations Section, now takes charge of the work relinquished.

Dr. William N. Berg, of the Pathological Division, Bureau of Animal Industry, Washington, D. C., has been appointed captain in the Sanitary Corps, with orders to proceed to the Yale Army Laboratory School, New Haven, Conn.

Dr. Alonzo E. Taylor has been called abroad in the interest of the Food Administration.

Professor H. Gideon Wells, of the University of Chicago and director of the Otho S. A. Sprague Memorial Institute, left Chicago on October 30 for special medical work under the auspices of the Red Cross organization in Roumania and Serbia. Dr. Wells has already spent several months in Roumania on a similar mission.

L. E. Call, professor of agronomy in the Kansas State Agricultural College, has been invited to go to France to become specialist in grain crops for the army overseas educational commission. The commission is to have charge of all educational work overseas among American soldiers during the war and during demobilization.

R. E. Tulloss, Ph.D. (Harvard, '18), has completed a year's work as consulting psychologist at the U. S. Naval Radio School, Cambridge, Mass. With the use of laboratory apparatus and technique, study has been made of the progress of some hundreds of students of radio telegraphy. Dr. Tulloss and Lieutenant W. E. Snyder, director of education at the Cambridge School, have collaborated in the preparation of a text-book for radio operating instruction.

Professor H. F. Moore, of the engineering experiment station of the university of Illinois, has been appointed by the National Research Council chairman of the committee to investigate the fatigue phenomena of metals.

Frederick Starr, associate professor of anthropology in the University of Chicago, is

now in Guatemala, where he is conducting special researches in his field.

MR. FRANK C. BAKER, curator of the Museum of Natural History, and Professor Frank Smith, of the department of zoology, University of Illinois, have been engaged during the past summer in making a mussel survey of the upper waters of the Big Vermilion River, with special reference to the effect of the sewage from Champaign and Urbana on the mussel fauna of the Salt Fork of the Vermilion River. Results have been obtained bearing on both the distribution of the river mussels in this stream and the effect of the sewage on this distribution.

MR. H. A. NOYES, research associate in horticultural chemistry and bacteriology at the Purdue Agricultural Experiment Station, has resigned to accept an industrial fellowship with the Mellon Institute, University of Pittsburgh.

DR. RHODA ERDMANN has returned to New Haven, her present address being 67 Trumbull Street.

PROFESSOR SELSKAR M. GUNN, one of the associate directors of the American Commission for the Prevention of Tuberculosis in France (the Rockefeller Foundation), gave a lecture, illustrated by lantern slides, at the annual meeting of the National Association for the Prevention of Consumption and other Forms of Tuberculosis, at London on October 29.

DR. JAMES JACKSON PUTNAM, emeritus professor of diseases of the nervous system in the Harvard Medical School, died at his home in Boston on the fourth instant, in the seventy-third year of his age.

DR. P. H. MELL, of Atlanta, Ga., died on October 12 at the home of his brother-in-law, Mr. V. M. Fleming, of arteriosclerosis. He was born in Athens, Ga., in 1850, the son of Dr. P. H. Mell, chancellor of the University of Georgia. He was for many years professor of natural science in the Alabama College and afterwards president of Clemson College, S. C. Since he retired from active college work he has been treasurer of the Home Mission Board of the Southern Baptist Convention.

UNIVERSITY AND EDUCATIONAL NEWS

DR. CHARLES LOCKE SCUDDER has been appointed acting dean of the Harvard Graduate School of Medicine.

PROFESSOR FREDERICK SLOCUM, who has been on leave of absence for a year in the service of the United States Shipping Board, training men for service upon the Merchant Marine, has resigned his position as director of the Van Vleck Observatory and professor of astronomy at Wesleyan University in order to become professor of navigation and director of the School of Navigation in Brown University. Professor Burton H. Camp, of the mathematics department, has been appointed acting director of the Van Vleck Observatory.

THE department of physiology of the University of Rochester has secured the services of Dr. M. H. Givens as assistant professor of biochemistry, and of Dr. Harry B. McClugage as instructor. The department is cooperating with the Division of Food and Nutrition of the Medical Department, U. S. Army, and with the Department of Agriculture, in the investigation of the antiscorbutic properties of dehydrated vegetables and fruits.

MURRAY P. HOROWITZ, instructor in the department of biology and public health of the Massachusetts Institute of Technology, has also been appointed instructor in advanced bacteriology in the botany department of Wellesley College.

PROFESSOR C. A. BARNHART, formerly of Carthage College, has been appointed professor of mathematics in the University of New Mexico.

BURNS OSCAR SEVERSON, formerly at the Pennsylvania State College, has accepted the position of associate professor in animal breeding at the Kansas State Agricultural College. This position was left vacant through the resignation of Captain E. N. Wentworth, who is now in France.

DISCUSSION AND CORRESPONDANCE

BOTANY AFTER THE WAR

There has been running in the issues of the *New Phytologist*, beginning in December, 1917, a discussion on "The Reconstruction of Elementary Botanical Teaching," which all American botanists alive to the future of their subject should read. British botanists are talking over ways and means of bettering their teaching with a degree of criticism and candor hopeful for significant reforms.

It is a discussion that should result in an attempt to modify elementary teaching in such a manner that certain material, some of it quite new to prevailing practise but believed to be of fundamental importance, shall find a place or adequate treatment in elementary courses. Since introductory courses can not be long courses certain subjects, some of them time honored, are brought into court to justify their value or to give way wholly or in part to the demands of the new.

The universities of the United States have this year been asked by the government to present in prescribed terms of twelve weeks a group of subjects for a very large body of men —the Student Army Training Corps. One of these is biology and in most cases the course is likely to be organized as of two subjects, botany and zoology, which, for practical reasons, will probably be treated in large measure apart from one another. Botany is, therefore, to be taught by a large number of instructors in courses that will approximate the equivalent of six or twelve weeks from nine to eighteen hours a week. The mental adjustments of the instructors to the pedagogical problems presented will be great, their reactions will be various. Compelled by the time limits to give a short course they must lay aside many a pet affection for this or that topic and practise a rigid selection of material to a degree never before demanded of them. There is certain to result from this large experiment a very considerable readjustment of values in the minds of those who organize the work. Botany after the war will not be taught in many institutions as it was before.

In the first place instructors will feel strongly the pressure to present practical aspects of the subject since their students are definitely fitting themselves for special fields of interest. There will not be time to develop in detail any of the great fields of botany, morphology, physiology or ecology. All that can be hoped is to give some understanding of plants as living things, with structure developed to accomplish certain results, with life habits adapted for certain ends, organisms that fit into a scheme of evolution subject to certain simple principles. Always in the mind of the teacher will be the desire to show how plant life works harm or renders service to man.

Since practical considerations are so largely to establish the ends toward which such a course will lead and to guide the lines along which the course is to be framed, and because the course must be short and the students will not in general have had much training in science, the problems of the selection of material and methods of treatment become tests of judgment more severe perhaps than any which ever before have been presented to teachers of biology.

Morphology obviously can not ask for much more than the opportunity to serve the requirements of physiology since a knowledge of structure is basic to an understanding of function and life processes. The study of comparative morphology with the end in view of developing phylogenetic relationships is clearly impossible in so short and condensed a course.

Physiology must content itself with simple considerations because the students will have had little training in physics and chemistry. General principles of plant physiology alone can be presented. Since the thought of the whole world is at present so largely centered on food problems the subjects of food elaboration and food storage should take a prominent place in the course.

Ecology has its part to perform but will be severely limited by the fact that extended acquaintance with groups of plants can not be given. It must rely chiefly on what general information the students may possess of forest, prairie, shrub and swamp vegetation, together with some elementary facts of physiography and geology.

Economic botany will make its demands wherever in the course appropriate connections can be made. Its importance is evident but it can hardly hope for much opportunity of consecutive treatment.

Of direct interest will be some of the lower plants in their relation to the subjects of sanitation, hygiene, fermentation, decay and to disease.

Finally such a course will miss an end, if the student fails to comprehend some of the simpler principles of organic evolution and the fundamental biological deductions which have so profoundly affected philosophy.

This is the general nature of the course to be tried out in our numerous institutions of higher education, and it seems not unreasonable to hope that the experiment may bring about a certain amount of agreement in the profession as to what may constitute the best introductory course in botany. Some possible results of the experiment and the discussions that formally or informally will come out may be briefly outlined.

Is it not probable that comparative morphology, based on type studies and having for its end the outlining of evolutionary relationships between the great groups of plants, must give way in introductory treatments and work out its ends through courses that will follow? Physiology and ecology in simple form may take a more prominent place, especially as they bear on such practical subjects as agriculture, forestry, etc. Fundamental principles of genetics for the same reasons will call for attention besides having their obvious connection with broad biological principles. Evolution may be treated not so much as a record of past accomplishments in phylogenetic history but with respect to the manner through which it is ever working. Economic botany seems certain to make important demand on the content of an introductory course.

Comparative morphology needs no advocate of its value and interest. Its followers may feel confident in the security of its position in botany. Those who teach it know that satisfactory results are not obtained when the subject is crowded for time. There are no short cuts to an understanding of morphological relationships. The basis of study must be detailed and thorough laboratory work. It is a fair question whether comparative morphology will not find greater satisfaction and obtain better results unfettered from the time limitations of the crowded introductory course with its necessarily mixed topics.

Morphology, physiology, ecology, genetics and the long list of special botanical subjects—none of them can hope to build upon an introductory course with any considerable degree of security. Each must construct its program according to its own special requirements frequently dependent upon other subjects or sciences. Physiology rests upon physics and chemistry; genetics makes use of mathematics; all special lines of botany require to some degree a knowledge of morphology.

Under these conditions will not the introductory course come more and more strongly to stand out as one that attempts nothing more than the grounding of fundamental principles and a selection of information with rather definite reference to its general and practical interests, or its broad philosophical bearing?

Bradley Moore Davis
Washington,
November, 1918

A POSSIBLE NEW FUNGICIDE FOR WHEAT AND BARLEY SMUT

The eradiction of stinking smut from wheat grown on the Pacific coast appears to be contingent upon the prevention of reinfection of treated seed by spores of smut in the soil or upon its surface. Even though the wheat farmer may have a smut free field, his soil is subject to infection by smut showers from his neighbors who thresh and blow into the air myriads of smut spores which are carried for miles by the winds.

Formaldehyde treatment for stinking smut in seed wheat, which has been found so effective and cheap in the states east of the Rocky Mountains where soil infection apparently does not occur, is ineffective against smut infected soils everywhere. This is due to the immediate evaporation of formaldehyde gas when the solution dries from the seed.

On the Pacific coast, wheat farmers have generally found that bluestone-treated seed escapes wholly or in part from soil infection. Bluestone solutions (1 pound to 4 or 5 gallons of water) are so strong that heavy loss in seed germination occurs. To prevent this loss, the bluestoned seed is dipped in a lime solution. This double dipping adds considerably to the cost and labor concerned in the seed treating process. Inquiries are frequently received requesting to know if the lime can not be mixed with the bluestone and but one dipping given. As the lime counteracts the effects of bluestone on smut spores, this process is not advisable.

In devising some means to meet the situation the writer devised tests using the lime sulphur-dip so universally used in spraying fruit trees for fungous pests. Preliminary tests with wheat and barley show the lime sulphur-dip at rather dilute solutions to be very effective against both stinking smut of wheat and covered smut of barley. As a thick coating of the dip adheres to the seed, it is quite effective against soil infection. The germ of seed wheat and barley dipped in a lime-sulphur solution even as strong as one part to one part of water gave, in these preliminary tests, no noticable deleterious effects on seed germination. If further more exhaustive tests confirm the preliminary ones, a fungicide which is much cheaper than bluestone and entirely lacking in destructiveness to the seed germ will have been secured.

W. W. Mackie

University of California,
Berkeley, Cal.

SCIENTIFIC BOOKS

A Text-book of Mycology and Plant Pathology. By John W. Harshberger. P. Blakiston's Son & Co., 1012 Walnut St., Philadelphia, 1917. With 271 illustrations, vii + 779 pages.

Students as well as investigators in mycology and plant pathology will greatly welcome the appearance of the above named work, by Dr. Harshberger. This is perhaps the only American book of its kind which treats of mycology in its true relationship to plant pathology. The book is of special interest, as it is written by a man who combines the knowledge and the technique of the old and the young botanist. Dr. Harshberger's work is the result of twenty-seven years experience in teaching and in preparing men for the botanical profession.

Like all other of his works, Dr. Harshberger's present book is very exhaustive; indeed it may safely be called an encyclopedia of mycology and plant pathology. It contains a wealth of information all written in concise language. It is also abundantly illustrated, and the numerous references will be especially welcomed by students and investigators. A book of this nature should not be judged by some few imperfections, or errors, in spelling, but rather by its scope and its ability to cover the field in a precise way. In this the author seems to have succeeded.

The book is divided into four parts:

Part I. deals with systematic mycology. It is divided into twenty-one chapters in which the Myxomycetes, the Schizomycetes and the Eumycetes are considered at length. The Myxomycetes receive a considerable share of attention and emphasis is laid on the pathogenic forms. A complete bibliography is also appended. The discussion of the Schizomycetes is taken up in a similar fashion as the Myxomycetes. The pages dealing with the fungi are preceded by chapters on histology, chemistry, physiology, ecology, etc. A comprehensive treatment of enzymes in fungi is also given. The chapter on the geographic distribution of fungi will be appreciated by the plant pathologist. The distinctive features of the taxonomic chapters on the fungi is that emphasis is laid on the forms pathogenic to plants.

Part II. takes up a general consideration of plant pathology. The various forms of disease, the predisposing factors, the symptoms, etc., are very clearly set forth.

Part III. deals at first with a list of specific diseases of economic plants. These are taken up alphabetically and the reader is referred to a list of fairly extensive agricultural experiment station bulletins. The second part of

Part III. goes into detailed account of specific diseases of plants in which the hosts are also taken up alphabetically. Only those diseases which are of economic importance are considered. The doubtful ones, or those of little economic importance, are omitted. Here plant pathologists will find ground to differ with the author in his choice of those specific diseases which he considers most important. The survey in the chapter of non-parasitic, or physiologic, diseases will be appreciated by the student.

Part IV. takes up a detailed account of laboratory and teaching methods. Here the author incorporates much of his own methods and technique. This part will be found of particular interest to the teacher of both undergraduate and graduate students. Part IV. is made up of forty-six lessons in which every phase of laboratory technique is elaborately and clearly set forth. Finally the book concludes with an appendix which considers the preparation of fungicides and insecticides, spray calendar, keys for determining species of *Mucor, Aspergillus, Penicillium,* Erysiphaceæ and the fleshy fungi.

The distinctiveness of the book is the extensive field which it covers in mycology and plant pathology. It stands by itself, in its difference from the average American text-book bearing on these subjects. The book fills a timely want, and it should find a place in every library of the teacher, investigator or student.

J. J. Taubenhaus

Texas Agricultural Experiment Station

THE ROYAL COLLEGE OF PHYSICIANS[1]

The four hundredth anniversary of the foundation of the Royal College of Physicians of London is an event which can not be allowed to pass without comment. On September 23, 1518, Henry VIII. granted the charter by which the college was constituted. He did so, moved by the example of similar institutions in Italy and elsewhere, and by the instigation of Thomas Linacre and others of his own physicians, and of Wolsey his chancellor, with a view to the improvement and more orderly exercise of the art of physic, and the repression of irregular, unlearned and incompetent practitioners of that faculty. The college consisted of eight persons known as "elects," with power to elect from amongst themselves a President annually, and to choose the "most cunning and expert men" to fill vacancies as occurred in their number. At the same time it was enacted that no person except a graduate of Oxford or Cambridge, without dispensation, should be permitted to practise physics throughout England, unless he had previously been examined and approved by the president and three of the elects. The first meetings of the college were held at Linacre's private house in Knightrider Street, the front portions of which, comprising a parlor below and a chamber above, used as a council room and library, were given to the college during Linacre's lifetime. These small premises—the ground on which they stood only measuring about twenty-four square feet—continued to be used for nearly a hundred years. But in 1581 they were enlarged, and a capacious theater added, in which to deliver the lectures founded by Dr. Caldwell and Lord Lumley, in 1583. Dr. Foster was the first Lumleian lecturer. A botanical garden, under the supervision of Gerard, was also secured. Linacre, founder of the college, learned both as physician and scholar, was president until he died in 1524. Of distinguished successors and benefactors of the college during its first hundred years of existence the names of Clement (1544), professor of Greek at Oxford; of Wotton, the zoologist; of Caius (1555), linguist, critic, physician, naturalist, second founder of Gonville and Caius College, Cambridge, antiquarian and designer of the insignia of office still used by presidents; of William Gilbert (1600), author of "De Magnete" and first physicist of the college, naturally occur to us. The last meeting in the old college in Knightrider Street was on June 25, 1614; the first meeting in the new college, in Amen Corner, Paternoster Row, was on August 23, 1614. Here, in April, 1616, Harvey

[1] From the *British Medical Journal.*

delivered the Lumleian lectures in which he is supposed to have expounded his doctrine of the circulation of the blood; two years later the first Pharmacopœia Londinensis was issued by the college. The civil wars reduced the college to the greatest distress. Unable to pay an assessment by Parliament of five pounds per week, and its rent to St. Paul's, it was in danger of being sold by auction, when Dr. Baldwin Hamley came to the rescue, purchased house and garden himself, and with the utmost generosity presented them to his colleagues two years afterwards. Prosperity followed, for in 1653–4 the munificence of Harvey enriched the college with a museum, a "noble building of Roman architecture," stocked with valuable and curious contents, and a library of medical books, treatises on geometry, geography, astronomy, music, optics, natural history and travels. But this prosperity was not long continued. After Harvey's death in 1657, the treasury was nearly empty, lectures were suspended, large numbers of physicians were living and practising without a license within the liberty of the college, examinations were discontinued. The creation in 1664 by Sir Edward Alston of upwards of seventy honorary Fellows, both brought unlicensed practitioners under the authority of the college and replenished its coffers. But in 1665, during the great plague, most of the Fellows and officers of the college fled the city, and thieves broke in and stole the whole of the contents of the treasury chest. On September 5, 1666, the great fire consumed the whole of the college buildings; only the charters, annals, insignia, some instruments and portraits, and 140 printed books in the library were saved. The premises in Amen Corner were never rebuilt, and the college remained homeless until its new buildings in Warwick Lane, designed by Sir Christopher Wren, were opened without ceremony on May 13, 1674. This commodious and stately building occupied four sides of a quadrangle enclosing a large paved court, on the east side of which was erected at Sir John Cutler's expense a spacious anatomical theater. The other sides of the quadrangle contained the library, cœnaculum, censors' room and other public apartments. At the back of the college were the botanical garden, and in 1684 a noble library building was presented by the Marquess of Dorchester. Here the college stood for 150 years; all that remains of it now is the beautiful Spanish oak wainscoting, the gift of Hamley, which lines the Censors' Room in Pall Mall, and two colossal statues of Cutler and Charles II, which may be seen in the Guildhall Museum. At the end of 150 years the college buildings had become dilapidated, Warwick Lane was a slum, the population and fashion had moved westwards, and a more convenient situation for the Royal College of Physicians was a necessity. Mainly through the influence of Sir Henry Halford, a grant of land was obtained from the Crown at a cost of £6,000 in Pall Mall East, and on it the present college building, designed by Sir Robert Smirke, was erected and opened with great ceremony on June 25, 1825. The premises in Warwick Lane were sold for £9,000. One may regret their disappearance, and that it is no longer possible to people them with the shades of those who have made the history of medicine and of this famous college during 150 years of its life. The names of such are Mayerne, Glisson and Sydenham, exponents of clinical medicine, followed by Radcliffe, Garth, Arbuthnot, Freind, Sloane and Meade, and last but not least, William Heberden. All of these have made their mark in the history of medicine, and directly or indirectly have been associated with the history of the college. The quartercentenary of the Royal College of Physicians of London reminds us that, in spite of modern progress, we can not afford to neglect the learning of past ages.

SPECIAL ARTICLES

SUGGESTIONS REGARDING THE CAUSES OF BIOELECTRIC PHENOMENA

Bioelectric phenomena constitute a group of facts for which adequate and satisfactory explanations have hitherto been lacking. It is my purpose in this paper to point out certain

significant correlations between these phenomena and the metabolic gradients which are now known to exist in organisms; and to propose an explanation of the former in terms of these gradients. The metabolic gradients were first demonstrated by Child in *Planaria;* subsequently he and his students extended the observations to include a large number of adult organisms, cells and embryos.[1] This work has shown that the anterior, oral or apical end of organisms has the highest metabolic rate and that this rate decreases along the sagittal axis. A gradient in rate of metabolism therefore exists along this axis; and to a less extent along other axis of symmetry also. This fundamental discovery has furnished a basis for the interpretation of many hitherto entirely inexplicable biological facts,[2] and I believe that it also throws light upon the nature of the bioelectric currents.

The term metabolism is too well understood to require definition; it commonly signifies the sum of chemical processes which results in the production of new protoplasm or other organic compounds, or of energy. "Metabolic rate" simply means the rate at which these processes take place; and modern chemistry, particularly through the study of organic and other catalyzers, has taught us the supreme importance of rate in any chemical system. The metabolic rate is generally measured either by the rate at which the raw materials, particularly oxygen, for the reactions are used up; or by the rate of production of end-products, especially carbon dioxide. The extent to which a given mass of protoplasm is actually alive is determined by its metabolic rate; these chemical reactions, always building and destroying, are the very essence of the living; when they sink to a rate so low that only the most delicate means serve to detect them, the organism is practically lifeless, but when they burn intensely, the most marvelous manifestations of protoplasm, such as thought, leap forth.[3]

The following suggestions are by no means entirely new; similar ones have already been made by Waller, Child and Tashiro.[4] In collaboration with Mr. A. W. Bellamy of this laboratory, I am collecting further data upon these matters, and the complete results, together with a more extended discussion of the literature, will appear later; but a sufficient number of facts are already known to justify a preliminary statement of the relation between metabolic conditions and differences of potential found in organisms.

1. *Permanent Differences in Potential.*—In a number of cases we know both the metabolic gradient and the permanent differences of electrical potential along the antero-posterior axis. Thus Mathews[5] in 1903 discovered that the head of hydroids is electro-negative to the stem, and that anterior levels are electronegative to posterior ones. Later, Child[6] demonstrated that in these animals the head or any anterior level has a higher metabolic rate than any posterior level.[7] Hyde[8] found

[1] Child, "Individuality in Organisms," Univ. of Chicago Press, 1915.

[2] Child, *Jr. of Morph.*, XXVIII., p. 65; XXX., p. 1; *Roux's Archiv*, XXXVII., p. 136; Newman, *Biol. Bull.*, XXXII., p. 314, are a few examples where such interpretation has been applied.

[3] Alexander and Cserna, *Biochem. Zeitsch.*, LIII., p. 106, have demonstrated that the oxygen consumption of the brain greatly exceeds that of any other part of the body.

[4] Child, "Individuality in Organisms," p. 63; Tashiro, "A Chemical Sign of Life," Univ. of Chicago Press, 1917; Waller, "Signs of Life from their Electrical Aspect," London, 1903.

[5] *Am. Jr. of Physiol.*, VIII., p. 294.

[6] SCIENCE, XXXIX., No. 993.

[7] An additional statement regarding the metabolic gradient in hydroids would seem to be required owing to the recent paper of Garcia-Banus (*Jr. Exp. Zool.*, XXVI., p. 265), who states that apical pieces of the stem of Tubularia do not regenerate oral hydranths faster than basal pieces. In the summer of 1914 at Woods Hole, while I was a student in Professor R. S. Lillie's class in physiology, I performed this experiment with the common tubularian hydroid found there, called at that time *Parypha*. I found the hydranths arising earlier on the apical pieces; the result was clear-cut and definite. The experiment has since been repeated at Woods Hole to my personal knowledge with the same result as mine. Driesch also (*Roux's Archiv*, IX., p. 130) found that oral

that the animal pole of turtle and other vertebrate eggs is electronegative to the vegetal pole, and the anterior ends of vertebrate embryos electronegative to posterior regions. Child[9] subsequently found in similar materials that the electronegative regions are also regions of high metabolic rate. Morgan and Dimon[10] reported that the anterior and posterior ends of *Lumbricus terrestris* and *Allolobophora* (*Helodrilus*) *fœtida* are electronegative to the middle. Mr. Bellamy has repeated this experiment and confirmed the result on *Helodrilus caliginosus*. In my work on the aquatic oligochætes,[11] I was able to show in a number of species that the anterior and posterior ends have a higher metabolic rate than the middle. The same state of affairs presumably exists in the terrestrial oligochætes also, although these can not be tested by the available methods for demonstrating differences in metabolic rate.

In these cases the regions of high metabolic rate are always permanently electronegative to regions of lower metabolic rate. This fact suggests the hypothesis that the metabolic differences are directly responsible for the differences in potential and that the latter are, therefore, of chemical origin. This is also the opinion of Child, and R. S. Lillie has recently come to a similar conclusion.[12] I am also in accord with R. S. Lillie regarding the chemical process which is at the bottom of these differences in potential,—namely, that it is an oxidation and reduction phenomenon. In considering this matter, one must remember that when one states that a given region is electronegative, one means electronegative with respect to the galvanometer, exactly as one says that the zinc pole of a cell is the negative pole; actually the zinc pole is positive to the carbon or copper pole, and similarly the regions of high metabolic rate are in reality electropositive to regions of lower metabolic rate. If one considers now the familiar "action at a distance" experiment of chemistry, in which the oxidation is carried out in one beaker, and the reduction in another, one finds the electrical conditions thus produced to be identical with those observable in organisms. The current runs in the galvanometer from the reduction beaker to the oxidation beaker, and in the bridge of salt solution from the oxidation beaker to the reduction beaker. The region of oxidation is thus, as also in the region of high metabolic rate in the organism, electronegative galvanometrically, actually electropositive. We have abundant evidence that the metabolic gradient runs parallel to the rate of oxidation. In the organism, however, oxidation and reduction are not separated as in our experiment, but there in all probability, the electric difference of potential is due to difference in rate of oxidation at difference levels,—in other words, to a concentration cell with respect to oxidation.

2. *The Current of Injury.*—It has long been known that any cut or injured surface is electronegative (galvanometrically as explained above) to intact surfaces. In this laboratory we have frequently observed that such injured surfaces always have a higher metabolic rate

hydranths appear earlier on apical than on basal pieces. In animals so lowly organized as the hydroids, where the metabolic gradient is well marked only near the apical end, practically lacking near the base, and very plastic and readily alterable by external factors, it is easy to select conditions under which the basal pieces will regenerate hydranths as fast as or faster than the oral ones; such conditions are: using long pieces, taking pieces from the more basal regions of the stem instead of from the apical regions, using basal pieces near the place where a branch is about to form, slight depressing conditions, etc. (the mere fact that pieces do well in the laboratory is not evidence that no depression existed; in fact, depressed pieces are more likely to survive than vigorous ones). Since Garcia-Banus mentions none of these factors in his paper, not even stating *whether his apical pieces are near the original hydranth or not,* it is presumable that he failed to control or eliminate them, and that this explains why he was unable to obtain the same results as other investigators.

[8] *Am. Jr. of Physiol.*, XII., p. 241.

[9] This work is largely unpublished. See, however, on amphibian embryos, Child, *Roux's Archiv*, XXXVII., p. 135.

[10] *Jr. Exp. Zool.*, I., p. 331.

[11] *Jr. Exp. Zool.*, XX., p. 99.

[12] *Biol. Bull.*, XXXIII., p. 181 ff.

than uninjured regions, as determined by our methods; and further that this increase in metabolic rate is the result of the stimulation of cutting, since it does not occur if the cutting is done under anesthesia. We have also shown that this alteration of metabolic rate as the consequence of injury occurs not only at the cut surface but involves adjacent uninjured regions also, in proportion to their distance from the cut. Tashiro[13] has further found that injury invariably increases the carbon dioxide output of living material, and he believes this reaction to injury to be an infallible sign that the material is living.

In the text-books of physiology, explanations of the current of injury are usually based upon supposed alterations of membranes, concentrations of electrolytes, etc., at the cut surfaces,—that is, the cut place is supposed to cause the phenomenon. But our observations show that the change in metabolic rate occurs not only at the cut surface but for some distance away from it; and an experiment of Bose[14] demonstrates that the region of electronegativity also exists not merely at the site of injury but for a considerable distance away, diminishing in fact with distance. Here again the current runs parallel with the metabolic conditions at and near the injured regions. Bose concluded that the actual injury to the cells is not directly the cause of the electronegativity but that the stimulation due to the injury produces the electric change; and this stimulation, like many others, is transmitted with a decrement to surrounding regions. Injury is thus a form of stimulation and our experiments and those of Tashiro show that the stimulation of injury produces in the organism an increase in metabolic rate. Hence, as in the preceding case, we may suggest that the current of injury arises through the fact that the site of injury and adjacent regions are regions of increased metabolic rate and thus are electronegative to intact regions, where the rate is lower.

3. *The Current of Action.*—Whenever any living material is "stimulated," the stimulated region becomes *ipso facto* a region of electronegativity with respect to non-stimulated areas. In order to analyze this universal phenomenon, it is necessary to know what the nature of stimulation is. Physiologists are still very far from a solution of this difficult and fundamental problem. I venture to suggest, however, that everything that we know about stimulation indicates that increase in metabolic rate is its principal characteristic. Thus the oxygen consumption increases, the carbon dioxide output increases, the production of synthesized materials and of waste products is accelerated, the energy produced is augmented.[15] Tashiro,[16] for instance, after testing various kinds of plant and animal tissues, says: "In all cases stimulation causes an increase in carbon dioxide. We could never find any response unaccompanied by an outburst in carbon dioxide."

Every cell carries on a specific kind of metabolism, resulting in specific end products. As far as we know, each cell is always producing these whether it is in a stimulated condition or not, and the rate at which it does this is a measure of the degree to which it is alive. Thus Tashiro finds that all living substances give off carbon dioxide, and the rate of this output runs parallel to other manifestations of life, as relative irritability, rapidity of response, rate of conduction, etc. Let us consider very briefly the three chief active tissues of the body,—gland, muscle and nerve. In any particular kind of gland cell, barring special experimental or pathological conditions, there are in general the same kinds of granules to be found at all times. As far as one can determine, the rate of formation and discharge of granules alone is variable,—not their content. The essential effect of stimulating the gland cell through its nerve is an increase

[13] A chemical sign of life.

[14] "Comparative Electro-physiology," 1907, pp. 154 ff. Bose has a great deal of interesting experimentation on the bioelectric currents but unfortunately it is often very difficult to grasp his exact meaning.

[15] These statements can be verified in any of the recent text-books of physiology as Bayliss, Howell, Stewart, etc.

[16] *Loc. cit.*, p. 99.

in the rate of production of its secretion. As is well known, this stimulatory increase in secretory products is always accompanied by large increases in the amount of oxygen consumed, CO_2 produced and heat evolved. In the case of muscle, the amount of lactic acid produced furnishes a certain criterion of the metabolic rate of the muscle. In the resting state, the lactic acid content is small; after the stimulation of injury and after contraction, it is greatly increased. And although molecular oxygen does not appear to be consumed in this process, the production of lactic acid from carbohydrates is nevertheless chemically an oxidation. In nerve, where it was long believed that no increase in metabolism occurred during the passage of the impulse, it is now known, thanks to the researches of Tashiro,[17] that a relatively great increase in carbon dioxide output is associated with the process. He also presents some evidence that the oxygen consumption is likewise accelerated, during the conduction. In this connection it may be mentioned that Alexander and Revesz[18] found that the oxygen consumption and the carbon dioxide elimination of the brain are increased when the retina is stimulated by light. In nervous, as in other tissues, the difference between the resting and the stimulated state is then largely quantitative. Further significant facts are that the rate of the passage of the current of action along the nerve bears a direct relation to the known irritability of the nerve and the rate at which it conducts the impulse; and as Tashiro's work shows that these factors are also directly related to rate of carbon dioxide production (more irritable nerves in the resting state giving off more of the gas than the less irritable ones), it becomes obvious that metabolic condition is the primary factor in the causation of the current of action.

The evidence then clearly indicates that each cell is always carrying on a specific kind of metabolism and that stimulation consists essentially in the temporary acceleration of the rate of metabolism. From this point of view regarding the nature of stimulation, the current of action is readily explicable. Any stimulated region is a region whose metabolic rate has been temporarily increased by the stimulation, and as in the preceding cases, it must necessarily form with non-stimulated regions of lower rate a concentration cell with respect to rate of metabolism. It must therefore be electronegative to such non-stimulated regions. The various kinds of bioelectric currents are thus conceived as referable to the same cause, differences in metabolic rate; and they are, apparently, merely the consequence of such differences, and of no significance in themselves.

This explanation of the current of action has been long held by Waller (*loc. cit.*), who on scanty and indirect evidence and in the face of skepticism from other physiologists maintained that the metabolism of nerves is the same as that of other protoplasm, that the current of action is due to sudden increase in their rate of metabolism, and that this current is merely a sign of that metabolic change. Waller's idea has received strong confirmation through Tashiro's work.

Certain interesting corollaries follow if this conception of the nature of stimulation is true. Thus if an increase in metabolic rate is the essential feature of stimulation, it follows that any organ or cell whose rate of metabolism is already sufficiently high will function without stimulation—in other words, it will be automatic. Some physiologists deny that there are any truly automatic organs, but surely the facts that are known about the heart, the medullary centers, and the digestive tract sufficiently prove that automaticity is a real phenomenon. Consider, for instance, the embryonic heart, which in all known cases, has a beat of myogenic origin. The metabolic rate of this young muscle tissue is in all probability so high that it contracts in the absence of stimulation from without. Later, as the rate falls with age, the aid of the nervous system must be evoked to keep the apparatus going. The nervous system is, indeed, the automatic structure *par excellence* of the body and,

[17] *Loc. cit.*, Chaps. II. and III., also p. 53.

[18] *Biochem. Zeitsch.*, XLIV., p. 95.

as our conception demands, it is characterized by an exceedingly high rate of metabolism. This is demonstrated not only by its blood supply, its great susceptibility to lack of oxygen, to anesthesia, to cyanide and other poisons, but also by direct measurements of its rate of oxygen consumption. Thus, Alexander and Cserna[19] find that the oxygen consumption of the brain is vastly greater than that of equal weights of any other organs, and MacArthur and Jones[20] that the cerebrum and cerebellum respire faster than any other parts of the central nervous system, the rate decreasing gradually from these parts posteriorly. The nervous system by virtue of its intrinsically high metabolic rate is able to control other parts of the body, and to increase their metabolic rates by sending impulses along the nerves.

It should be mentioned that stimulation is characterized not only by the acceleration of the metabolic processes but also by other changes, which may well be the consequences of this acceleration, such as alteration of the colloidal state (probably in the direction of liquefaction), increase in permeability, and other effects.

4. *Galvanotaxis*.—The metabolic gradient also furnishes us with a logical explanation of the phenomena of galvanotaxis. It is well known that many animals when placed in an electric current will turn their anterior ends toward the cathode and travel to the cathode, maintaining such an orientation. Now as I pointed out in the first section of this paper, the anterior ends of a variety of organisms have been shown to have a higher metabolic rate than other parts of the body and to be electropositive (internally) to other parts. Since then the anterior end is positively charged or at least possesses the properties of an anode, it must when placed in the current be directed toward the cathode and it will tend to travel towards the cathode like any other positively charged material. Animals on the same basis might also travel backwards to the anode. Galvanotaxis is then a real taxis, or forced orientation, in the sense of Loeb. A crucial test of this hypothesis can be made upon the oligochaete worms, where, as we know from experiment, there are two regions of high metabolic rate and of electropositivity,—namely, the anterior and posterior ends. These animals should then when placed in a current bend themselves into a U-shape, head and posterior end directed towards the cathode, and middle towards the anode, and travel to the anode maintaining such a posture. This is exactly what they do as first pointed out by Moore and Kellogg[21] and since confirmed by Mr. Bellamy.

5. *Other Electric Phenomena*.—Since regions of high metabolic rate are electropositive (internally) to regions of lower metabolic rate, it follows that if any region can be made electropositive by running a current through it, that region must then have its metabolic processes accelerated and must thereby be stimulated, must become more irritable. That this is true is a familiar fact in electrophysiology. A constant current stimulates at the cathode when the current is made—that is, the region around the cathode becomes positively charged (or possibly becomes an anode in some other way), and hence has a higher metabolic rate, and serves as the source of the response. Similarly on the break of the current, the area of stimulation is that surrounding the anode, it having been shown that on the break the anode is really temporarily a cathode. Electrotonus is the same phenomenon. After prolonged passage of the electric current through a tissue, a large region around the cathode becomes excessively irritable because it is full of positively charged particles,[22] and a large region around the

19 *Biochem. Zeitsch.*, LIII., p. 106.

20 *Jr. of Biol. Chem.*, XXXII., p. 259.

21 *Biol. Bull.*, XXX., p. 131.

22 I do not wish to be understood as stating positively that the electrical sign of various parts of the organism is actually due to their containing free particles of that sign. This seems the most convenient way of putting the matter but the facts in themselves do not serve to determine whether the charge is on the inside or on the surface or indeed what condition is responsible for it. The facts of electrotonus would seem to favor the idea that the charged particles are inside.

anode loses its irritability because it is negatively charged.

A detailed report of the experiments which we are conducting on galvanotaxis and electrical gradients in organisms will, of course, appear elsewhere.

L. H. Hyman

Hull Zoological Laboratory,
University of Chicago

THE AMERICAN MATHEMATICAL SOCIETY

The two-hundredth regular meeting of the society was held at Columbia University on Saturday, October 26, 1918. War conditions were reflected in an attendance of only eleven members. Professor E. W. Brown, of Yale University, presided at the morning session, and Professor O. E. Glenn, of the University of Pennsylvania, at the afternoon session. The following new members were elected: Professor R. A. Arms, Juniata College; Professor M. D. Earle, Furman University; Professor Ernest Flammer, Queen's University; Professor Gillie A. Larew, Randolph-Macon Woman's College; Dr. Flora E. LeStourgeon, University of Chicago; Professor John Matheson, Queen's University; Mr. F. R. Morris, University of California; Professor Susan M. Rambo, Smith College; Dr. W. G. Simon, Adelbert College. One application for membership was received.

A list of nominations for officers and other members of the Council was prepared and ordered printed on the ballot for the annual election in December. A committee was appointed to audit the accounts of the Treasurer for the current year. A committee was also formed to collect funds for a suitable memorial to the late Professor Maxime Bôcher, of Harvard University, who was president of the society in 1909–1910.

The following papers were read at this meeting:

J. E. McAtee: "The transformation of a regular group into its conjoint."

E. W. Chittenden: "On the Heine-Borel property in the theory of abstract sets."

G. A. Larew: "Necessary conditions for the problem of Mayer in the calculus of variations."

D. M. Y. Sommerville: "Quadratic systems of circles in non-euclidean geometry."

M. B. Porter: "Derivativeless continuous functions."

G. H. Hallett, Jr.: "Concerning the definition of a simple continuous arc."

R. L. Moore: "A characterization of Jordan regions by properties having no reference to their boundaries."

R. L. Moore: "Concerning simple continuous curves."

Edward Kasner: "Fields of force and Monge equations."

It was decided to hold the annual meeting of the society at Chicago in the Christmas holidays. No eastern meeting will be held at that season. But members attending the Baltimore meeting of the American Association are invited to read their papers before Section A, after registering titles and abstracts with the Secretary of the Society for record in the report of the Chicago meeting.

The southwestern section will not hold its Thanksgiving meeting this year. The February, 1919, meeting of the society will also be omitted. A regular meeting will be held in New York on April 26. The official list of officers and members will not be published in 1919.

F. N. Cole,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, NOVEMBER 29, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE PURPOSE OF RESEARCH[1]

ONE of the articles of the constitution of the Society of Sigma Xi provides that the president shall explain to the members-elect the aims and objects of the society, and it is in accordance with this requirement that I now have the pleasure of addressing those who have been, by our active membership, adjudged worthy of enlistment with us in the army of investigators and research workers whose goal is the discovery of all truth.

Our constitution sets forth that the society exists for the purpose of encouraging investigation in science, pure and applied, and limits its membership to those who have shown either noteworthy achievement as original investigators or who have given promise of marked ability in research; and if the reward of membership has not proved to be sufficiently adequate and compelling in the promotion of investigation, the society must, if true to its purpose, devise other ways of securing and developing the spirit of research, which is its excuse for existence.

With this in mind, I think, Professor Stieglitz, of the University of Chicago Chapter, has recently proposed that the society at large establish at least three Sigma Xi fellowships, with an income of at least $1,000 each, as a practical method of stimulating and strengthening ardor for research, since the award of a national Sigma Xi Fellowship would stamp the recipient as one of whom much is expected and would

[1] Presidential address to members-elect, Alpha Chapter, Sigma Xi Society, April 20, 1918.

encourage and enhance the working powers of the successful candidates.

Professor Mann, in his forthcoming report to the Carnegie Foundation, on Technical Education, discusses the various methods by which improved scholarship may be secured and he alludes to the part played by the possibility of membership in Phi Beta Kappa, Tau Beta Pi and Sigmi Xi, as valuable incentives to persistent application. But Professor Mann has sadly confused the ideals of the three societies when he puts them on the same basis. Scholarship, as Phi Beta Kappa and Tau Beta Pi know it, is vastly different from the scholarship that Sigma Xi exists to foster, and there are among you those whose mentality and methods of work, whose scholastic record would undoubtedly shut out from either of the first two but entirely justify your membership in the last. To be able to pass examinations of a conventional type, to follow along well-marked paths, even with occasional obstructions is in marked contrast, educationally, from blazing a new way. You have been judged, either on the evidence of actual accomplishment or on the promise of marked ability, to be capable of leading, rather than of following, of making discoveries for yourselves rather than of assimilating the results of others' work. The field included in the ideals of the society is unlimited. Science, either pure or applied, certainly includes everything that affects life and living, provided the matter be approached in a scientific spirit, and while the society in the past has emphasized pure science and is likely to do so even more in the future, so that the membership has been found largely among those who are searching for evidences of the abstract laws of scientific truth, it has also welcomed those who have applied such laws to the benefit of industry and of human development.

Professor Noyes, of the University of Illinois Chapter, has recently dwelt on the higher character of what he calls "discoveries" as compared with "inventions" though he grants that the society exists for the furtherance of both. He compares the value and genius of Faraday, a true discoverer, with the work of Morse, who applied only the earlier researches in electrical and magnetic induction to the construction of the telegraph. He refers to the basic discovery of Newton and disparages the applications of that discovery made by Newton's followers. In the same way, Pasteur's epochmaking discoveries in bacteriology and epidemiology might be compared with the applications made by his followers, Lister, Behring, Roux, Flexner, Metchnikoff and a host of others.

But the great majority of us can not hope to make discoveries and it may reasonably be asked whether the aim of the society will not be met quite as well by applying scientific law to practical problems as by persistently enquiring into some scientific field, a little corner of which seems to offer a chance for new discovery. Professor Titchener, some years ago, dwelt on the need for the true research worker to be unselfish, to forget the thought of reward either through some practical application or through financial appreciation and he held out to members the idealized promise that only in the consciousness of faithful service to an abstract desire for truth could reward be looked for.

But to an engineer, accustomed by training and habit to look on science and scientific laws as valuable only when capable of application and in these times when the whole world has been awakened to the fact that men skilled in research are indispensable to the prosecution of our world war, when the value of these very applications is everywhere recognized and when workers

are abruptedly snatched from the peacefulness of their quiet laboratories to tumult of the very battle-field itself, a plea for greater recognition in our membership of those whose interests lie in the practical side of science and a summons to a broader outlook in that field of enquiry may be permitted.

It is of course not forgotten that discoveries must always precede invention and that the smallest triumph in pure science may have unexpected and far-reaching results, so that the devoted investigator will always with us remain an honored and appreciated member. But in a world where unhappiness, injustice and distress are constantly in evidence, where conflict between classes is always on the point of breaking out, and where inefficiency and waste are everywhere, what greater service can the altruistic scientist do than to reduce the causes of the apparent sources of misery to known terms so that there may be some hope of reducing their effect if not of shutting them out altogether. The great Teacher promised that the poor we should always have with us. But it is not too much to look forward to that, through the more equable distribution of wealth, through better ways of fitting workmen to their tasks, through approved methods of reforming misdemeanants and of punishing criminals, we may greatly diminish the number of the poor. Why should not some of the researches of the society be made in the field of sociology, since we now honor with membership those who have studied practical problems in psychology. Why not in industries as well as in engineering?

Three fields, and doubtless there are others equally important, have suggested themselves to my mind as belonging to the category that I have tried to suggest: that of labor efficiency, that of industrial production, that of technical education.

The question of the efficiency and control of labor has always been perplexing to engineers and generally to employers. At the close of this present war, if the many predictions now being made have any basis whatever, the right answer to the labor problem must be found or else the whole world will be again bathed in blood in a still fiercer conflict, involving the very right to live, between employer and employee. It is predicted, as you know, not merely that all autocratic government will disappear, but also that labor will "come into its own," whatever that means. Recent happenings in Russia have not given evidence of the success of a government when the governors are narrowminded, unused to the consideration of large problems and unable to think of more than the present. Why should not this Society of Sigma Xi investigate some of the labor problems, as yet unsolved, in the hope of so definitely fixing fundamental laws that their permanence and binding character would be understood and perhaps made the basis of understandings otherwise impossible.

There would be many advantages in the trained scientific mind coming to the consideration of such a question as "Can a woman do the same amount of physical work as a man?" and settling it without reference to sentiment or public clamor. Some years ago, Mr. Frederick W. Taylor undertook to develop a body of scientific law that should govern the organization and operation of any industry and he gave to his studies the appropriate term, "Scientific Management," because, he said, such control is distinctively scientific in that it aims to correlate and to systematize all the best of modern developments in factory administration and to push development further in accordance with the principles discovered. It rests on laws and principles rather than on policies.

He emphasized the need for the adjustment of each individual to his special task, the need for better training for its better accomplishment and the predetermined and conscious stimulation of the workman to his greatest degree of exertion consistent with his continued health by means of a special reward in the form of a bonus for superior accomplishment. How to adjust an individual to any special task is plainly a matter for scientific study and the work of the late Professor Münsterburg, incomplete though it was, shows the vast possibilities of this kind of work. The recently devised tests for the fitness of aviators are of the same sort and the newly promulgated order of the War Department that all soldiers shall be tested by trained psychologists and the number of our faculty, members of this society, that have been taken for this purpose is another evidence of the feeling that there is a definite relation between the mind or attitude of the laborer and the work that he has to do.

One of the most important parts of Mr. Taylor's study was the investigation of the amount of work that a capable workman can produce in a day, a study carried on with a stop watch reading to fractions of a second and this led to an analysis of the elementary motions needed for any operation and to the elimination of all unnecessary ones. His work was however not exhaustive but rather suggestive and a great deal of investigation in his field remains to be done. Some attention has already been given to the inefficient management of household economy and to the possibility of applying the Taylor principles to domestic management. Our own department of domestic economy has published some suggestive bulletins on various phases of his subject although as in factories it is sometimes easier to point out the losses than it is to persuade the workers to avoid them. An amusing series of stories about "Efficiency Edgar" appeared in the *Saturday Evening Post* in 1916, giving an imaginary account of the possibilities of this important sort of efficiency housekeeping.

In the university we may not make our enquiries directly on the operation of factories but our university community is in many ways only a factory of a certain sort whose product is men and women instead of things and many factory problems may be studied here as well as elsewhere.

We might, *e. g.*, make scientific enquiry into such questions as:

What is the necessary rest period during the course of any working day?

Do students accomplish the same amount of work in the same number of days of a term, with and without vacations?

What tests can be applied to candidates for admission to the college of agriculture to determine their fitness for directing dairy work, or for agronomy, or for any other kind of agricultural work?

What inducements, that is, what kind of bonus, may be offered to students so that they shall be persuaded to really work for an education?

How shall a student know when he has reached the limits of his powers of application in the preparation of any lesson, so that a change of occupation is desirable?

How may competition be made use of in educational processes as in industry?

How much sleep does a student need?

How much food does a student need as compared with the military ration that has been found desirable?

Such studies would of course be widely different from the microscopic investigations of such subjects as:

"The Classification of the Larvæ of Ground Beetles," in zoology; "The Molecular Arrangements in the Camphor Series"

in chemistry; "The Fusarian Wilt in China Asters," in botany; or, "The Nature of Ionization of an Atom of Mineral Sulphide" in physics; to take a few of the subjects studied by those members admitted last year. But their general interest and value can not be gainsaid, nor can their fitness for presentation as evidence of the ability of the investigators for admission to the Sigma Xi Society be doubted.

Next to the many big problems of labor, crying for scientific treatment, come questions of industry. Industrial research is no new thing in America and the development of industrial Germany has been due to awarding governmental subsidies for chemical and other research workers. The Bell Telephone Company has had a research department for some forty years, advancing from a small beginning to a great institution, employing hundreds of scientists and engineers. In a recent address, the director of the research laboratory of the General Electric Company, Mr. Whitney, urged the value of research work in universities where the foundation for industrial advance can be well laid by trained workers. Dr. Steinmetz has urged many times the need of university training and has pointed out the fact that only because the demand for the results of scientific research has been so great that the universities have not been able to supply the demand the industries have had to enter the field of research themselves. He believes that some kinds of research can be best carried out by educational institutions, such as those requiring large amounts of time and attention, while others, requiring large amounts of material and power are better adapted to the industries. The latter also are more likely to limit the field of their investigations to some particular problem, to seek to meet some particular competition and to provide in some line a special efficiency.

The National Research Council is to-day, through coordination of research work, offering to the government the results of scientific studies of various war problems. The council has been able to assign properly qualified men to the solution of special problems as they have arisen. They have already pointed out the shortage of men properly equipped for high-grade research work and that the industrial efficiency of this country at the close of the war may be hindered by the failure of the universities to turn out men so qualified. In England the need for industrial research has led to various kinds of industry combining to maintain laboratories in which certain evident problems may if possible be solved. The Rockefeller Institute for medical problems and the Mellon Institute at Pittsburgh for the study of manufacturing operations are both splendid examples of the big returns that come from the application of pure science to problems of life and industry. In Professor Duncan's "Chemistry of Commerce," he says:

> Everywhere throughout America, wherever there is the smoke of a factory chimney, there are unsolved, exasperating, vitally important manufacturing problems, problems in glass, porcelain, starch, tanning, paints, drugs, meats, iron, oil, metallurgical products, problems wherever man deals with substances. It seems clear that these problems can best be answered by combining the practical knowledge and the large facilities of the factory with the new and special knowledge of the universities and by making this combination through young men who will find therein success and opportunity.

And what answer does Sigma Xi give to the call from industry for help in solving its insistent industrial problems? What work is going on in the chemical and physical and engineering laboratories that will bring direct aid to the sorely perplexed

managers of factories? But little, it must be confessed, though this may be from a failure of the industry to let its wants be known. Such subjects as "Arsenic in Filter Alum," "The Chemistry of Liquid Manure," "The Fertilizer Value of Activated Sludge," "The Effect of Gas-house Waste upon the Organic Matter in Streams" are recent general Sigma Xi studies in my own field. But special problems for particular manufacturers do not seem to reach the universities. Our eager workers do not seem to know of them and the practise seems to be growing of sending to the universities where laboratories and advice may be had agents of the industries, industrial Fellows, as they are called, to do work for special interests. Even the employees of the United States government come to the colleges and work on problems that the government needs to have solved.

The present war has brought to a crisis the failure of this country to provide for the manufacture of optical glass. Our navy has been begging from patriotic citizens their field glasses so that the ships of the navy shall not go blindly directed. England has felt the same lack and is meeting the urgency of the problem of manufacture by a special committee of scientists to whom has been referred such questions as "What are the desirable raw materials for optical glass?" "What are the optical properties of all the different kinds of glass?" "How should glass be tested for its optical properties?" "How should the surfaces of lenses be designed?" Why should not Sigma Xi workers give their attention to such practical problems?

In one of this year's *Atlantics*, is an article by Professor Ames, director of the Physics Laboratory of Johns Hopkins, describing in the most graphical way the applications of science to the carrying on of the war, as he himself saw it at the front. He confidently predicts the success of the Allies because, he says, at first the Germans profited by the advice of their scientists but now these have all been replaced by regular army officers, while, on the contrary, more and more have the operations of the Allies been guided by scientific advice. Professor Ames shows how geology, meteorology, physics and chemistry, each with many branches, are doing yeomen service and making success certain through the marked superiority of the Allies in the very kind of work that Sigma Xi exists to foster.

And finally there are problems of education to be treated with a scientific spirit. For educators are getting restless under the spur of constant criticism of methods and of results. So much is being said of the failure of universities to turn out men and women whose minds are really trained, who have more than a smattering of ideas in their heads, that faculties are asking themselves whether they are really alive to their responsibilities, and whether the time-worn theories of education may not need revision, in view of changed industrial and social conditions. Ex-president Eliot is a champion of revised teaching in the secondary schools, on the ground that present urban conditions do not train children to see and to hear accurately and that the present methods generally contain no significant element of sense training. He would cultivate mental vigor by association with bodily work and increase the power of mental concentration by work in carpentry and farming. Abraham Flexner goes farther and would eliminate all the old curriculum and build anew on the four foundation stones of science, industry, esthetics and civics, developing each from the child's senses and from laboratory training.

Perhaps a larger conception is found in

those who criticize the present methods for emphasizing the virtues of obedience and discipline and for failing to promote independence, and impulse, and constructive doubt, and spontaneous enquiry.

Undoubtedly modern educators substitute largely passive acceptance for creative thought, a substitution that is deadening rather than stimulating, and it is to the credit of Sigma Xi that thirty years ago it was founded to do its part in persuading students to see and to think for themselves and to make deductions, based on their own studies.

The old-fashioned teacher says that by the old régime was bred a sense of obligation, a respect for authority, a readiness to respond to the call of duty, traits that are sadly missed in the rising generation; while the opposition claim that these good qualities need not be sacrificed in the modern attempt to arouse individuals to mental alertness and self-reliance.

A few years ago, one of the former members of this chapter came to be in charge of a class in applied mechanics in a western university and he tried an experiment. Instead of teaching general laws by lecture and recitation, he gave out practical problems on pressures and on strength of beams and guided the students into a knowledge of the laws by which that particular problem could be solved. He reports a greater understanding of the principles than ever before and an unheard of enthusiasm for the subject. With so many of us teachers, why should not we turn our scientific minds on to the problems of effective teaching? It can not of course be altogether mechanical. We can not invent any adequate system of gauging the intelligence, or of regulating hours of study, of composing syllabi or of imposing quizzes, until work goes on with the pressure and dispatch of an engine room, the product accurately measured in kilo-watts or in foot-pounds. But we may properly make investigations into the subject with a view of getting the greatest return for the energy expended.

The questions of foundation and fundamental subjects needed in professional work is both delicate and important. Shall an engineering student spend twelve hours or five hours on analytics and calculus in preparation for civil engineering? is a question to be solved only by turning the technical school into a laboratory and experimenting on the subject. Shall physics be taught as theory or as a laboratory exercise and how many elementary principles of physics does an engineer really need? is another most pertinent question. Why does the engineer need to spend three years in his preparatory school on a modern language that apparently has no further bearing on his college course? is another perplexing question perhaps not so easily adjusted to laboratory tests. But experiments on inducements to study, on stimuli and incentives might be carried on almost without number. The general faculty have been considering inducements for the improvement of scholarship, all based on scholastic rank, on marks, an extraordinary spectacle that the faculty especially of arts, burdened with the task of imparting culture and mental discipline should think that scholarship can be compared and measured by numerical grades. What our society could do is to determine experimentally the best methods of teaching, the best methods of competition to compel students to rouse themselves and develop their ambition to excel. Once mothers gave their children in the spring nauseous doses of sulphur and molasses to purify their blood and for many years that magic phrase was sufficient justification for the practise. Is there not something of the same sort going on in educational matters, and how shall

the truth be known unless we, who have educational laboratories at our hands, make use of them.

May I then express the hope that among you, the newly elected members, there may be some who will find the subjects for their future experimental work, not in abstract research, without thought of reward, carried on in the sole interest of science, but rather in modern practical applications, in attempted solutions of the many insistent problems of labor, industry and of education, that the existence of the university may be more fully justified and the purpose of the Society of Sigma Xi the better realized.

H. N. OGDEN

CORNELL UNIVERSITY

INDUSTRIAL RESEARCH AND NATIONAL WELFARE[1]

I HAVE no justification for expressing views about scientific and industrial research except the sympathetic interest of an observer for many years at rather close range. One looking on comes to realize two things. One is the conquest of practical life by science; there seems to be no department of human activity in which the rule of thumb man has not come to realize that science which he formerly despised is useful beyond the scope of his own individual experience. The other is that science like charity should begin at home, and has done so very imperfectly. Science has been arranging, classifying, methodizing, simplifying everything except itself. It has made possible the tremendous modern development of the power of organization which has so multiplied the effective power of human effort so as to make the differences from the past seem to be of kind rather than of degree. It has organized itself very imperfectly. Scientific men are only recently realizing that the principles which apply to success on a large scale in transportation and manufacture and general staff work apply to them; that the difference between a mob and an army does not depend upon occupation or purpose but upon human nature; that the effective power of a great number of scientific men may be increased by organization just as the effective power of a great number of laborers may be increased by military discipline.

This attitude follows naturally from the demand of true scienific work for individual concentration and isolation. The sequence, however, is not necessary or laudable. Your isolated and concentrated scientist must know what has gone before, or he will waste his life in doing what has already been done, or in repeating past failures. He must know something about what his contemporaries are trying to do, or he will waste his life in duplicating effort. The history of science is so vast and contemporary effort is so active that if he undertakes to acquire this knowledge by himself alone his life is largely wasted in doing that his initiative and creative power are gone before he is ready to use them. Occasionally a man appears who has the instinct to reject the negligible. A very great mind goes directly to the decisive fact, the determining symptom, and can afford not to burden itself with a great mass of unimportant facts; but there are few such minds even among those capable of real scientific work. All other minds need to be guided away from the useless and towards the useful. That can be done only by the application of scientific method to science itself through the purely scientific process of organizing effort. It is a wearisome thing to think of the millions of facts that are being laboriously collected to no purpose whatever, and the thousands of tons of printed matter stored in basements never to be read—all the product of unorganized and undirected scientific spirit. Augustus De Morgan denying the divinity of Francis Bacon says "What are large collections of facts for? To make theories *from*, says Bacon to try ready made theories *by*, says the

[1] A statement made by the Honorable Elihu Root at the initial meeting of the Advisory Committee on Industrial Research of the National Research Council, held in New York on May 29, 1918.

history of discovery; it is all the same, says the idolator; nonsense, say we." Whichever it may be, the solitary scientist is likely to put a great part of his life into the pathetic futilities illustrated by De Morgan in the "Budget of Paradoxes." He needs chart and compass, suggestion, direction, and the external stimulus which comes from a consciousness that his work is part of great things that are being done.

This relation of the scientific worker to scientific work as a whole can be furnished only by organization. It is a very interesting circumstance that while the long history of science exhibits a continual protest against limitations upon individual freedom, the impulse which has called in the power of organization to multiply the effectiveness of scientific and industrial research to the highest degree is the German desire for military world dominion, supported by a system of education strictly controlled by government. All the world realizes now the immense value in preparing for the present war, of the German system of research applied at Charlottenburg and Grosslichterfelde. That realization is plainly giving a tremendous impetus to movements for effective organization of scientific power both in England and in the United States,—countries whose whole development has rested upon individual enterprise. It remains to be seen whether peoples thoroughly imbued with the ideas and accustomed to the traditions of separate private initiative are capable of organizing scientific research for practical ends as effectively as an autocratic government giving direction to a docile and submissive people. I have no doubt about it myself, and I think the process has been well begun in England under the Advisory Council of the Committee of the Privy Council for Scientific and Industrial Research, and in the United States under the National Research Council. I venture to say two things about it. One is that the work can not be done by men who make it an incident to other occupations. It can be encouraged of course by men who are doing other things, but the real work of organization and research must be done by men who make it the whole business of their lives. It can not be successful if parcelled out among a lot of universities and colleges to be done by teachers however eminent and students however zealous in their leisure hours. The other thing is that while the solution of specific industrial problems and the attainment of specific industrial objects will be of immense value, the whole system will dry up and fail unless research in pure science be included with its scope. That is the source and the chief source of the vision which incidently solves the practical problems.

We are thinking now mainly of science as applied to war; but practically the entire industrial force of mankind is being applied to war, so that our special point of view takes in the whole field. It is quite certain that if the nations on either side in this war had been without a great fund of scientific knowledge which they could direct towards the accomplishment of specific things in the way of attack and defense, transportation and supply of armies, that side in the war would long since have been defeated. Germany had the advantage at the start, because she had long been consciously making this kind of preparation with a settled purpose to bring on the war when she was ready. It would be the height of folly for the peaceable law-abiding nations of the earth ever to permit themselves to be left again at a disadvantage in that kind of preparation. Competency for defense against military aggression requires highly developed organized scientific preparation. Without it, the most civilized nation will be as helpless as the Aztecs were against Cortez.

We are not limited, however, to a military objective, for when the war is over the international competitions of peace will be resumed. No treaties or leagues can prevent that, and it is not desirable that they should, for no nation can afford to be without the stimulus of competition.

In that race the same power of science which has so amazingly increased the productive capacity of mankind during the past cen-

tury will be applied again, and the prizes of industrial and commercial leadership will fall to the nation which organizes its scientific forces most effectively.

MAXIME BOCHER[1]

Maxime Bôcher was born in Boston on August 28, 1867. His father, Ferdinand Bôcher, came to this country from France at the age of fifteen. His mother was Caroline Little, of Boston, a descendant of Thomas Little, who came to Plymouth in the early days of the colony and in 1633 married Anne Warren, the daughter of Richard Warren, who came in the *Mayflower*. Ferdinand Bôcher was the first professor of modern languages at the Massachusetts Institute of Technology; he was called to Harvard shortly after Mr. Eliot became president. Thus Maxime grew up under the shadow of the college, attending various schools in Boston and Cambridge; but it was chiefly by the stimulating influence of his parents, he tells us in the vita of his dissertation, that his interest in science was awakened.

He graduated at the Cambridge Latin School in 1883 and took the bachelor's degree at Harvard in 1888. Then followed three years of study at Göttingen, where he received the degree of doctor of philosophy in 1891, and at the same time the prize offered in mathematics by the philosophical faculty of the university. From 1891 till his death, which occurred at his home on September 12, he was a member of the department of mathematics. He married Miss Marie Niemann, of Göttingen in 1891. His wife and three children, Helen, Esther and Frederick, survive him.

He came to Göttingen at a time when Felix Klein was probably the most inspiring teacher of mathematics in the whole world. Breadth and accuracy of scientific knowledge and a true sense of proportion, combined with extraordinary powers of presentation, were characteristics of this great leader, whose scientific productivity had already secured for him high standing among mathematicians.

It was from this environment that Bôcher came to Harvard to take up the profession of mathematics. His skill as an expositor in the classroom, before a scientific audience, and on the printed page shone out from the beginning of his career, but the originality of his mind saved him from ever becoming a mere expositor. As a lecturer he was preeminent among American mathematicians.

It is not difficult in science to find important problems which can not be solved, or unimportant ones which can be. Bôcher was successful in discovering subjects on which the advanced student could work with a reasonable prospect of securing results of value. He did not foster research by excessive praise, and his pupils sometimes felt that he was unappreciative. But a scientific contribution of real merit never failed to secure his attention, and he had infinite patience in helping the student who was really making progress to develop his ideas, to see that which was new in its true perspective, and to put his results into clear and accurate language.

As a scientist Bôcher was highly critical. It was, however, the constructive work called for when criticism has exposed errors or disclosed deficiencies, not the destruction with which an unimaginative mind is content, that to him was the important thing. He had extraordinary powers of judgment, both within the domain of pure science, and in things relating to the policies of institutions. His judgment of men, too, was accurate. For these reasons he was unusually well qualified to take a leading part in the affairs of the American Mathematical Society, which came into existence at the beginning of his scientific career. He became its president, and he served with marked success on the editorial board of its *Transactions*. He also contributed in no small measure toward helping the university to build up a strong department of mathematics.

The decade in which Bôcher's career as a university teacher began was marked by an awakening of the science of mathematics in this country. His scientific contributions were

[1] Minute on the life and services of Professor Bôcher placed upon the records of the faculty of arts and sciences, Harvard University, at the meeting of October 22, 1918.

of a distinctly high order, and their volume was not small. He early took a stand among the foremost investigators of the country, and his work met with generous appreciation abroad. On invitation, he delivered an address at the St. Louis Congress in 1904 and a lecture at the Fifth International Congress of Mathematicians at Cambridge, England, in 1912, and he was exchange professor at Paris in 1913–14.

His life was lived within the academic walls, and while he took keen interest in current events of the world about him, his contact with men outside of university circles was not broad, and his judgment of them was sometimes severe. But when opportunity presented itself to help in time of trouble, he was quick to respond. He sought relaxation from scientific labor in literature, philosophy and music, rather than in social gatherings.

Those who stood nearest him will remember him best for the singleness of his purpose, the constancy of his effort, and the greatness of his ideals.

THE BALTIMORE MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE American Association for the Advancement of Science will hold its seventy-first meeting in Baltimore from December 23 to 28, 1918. This will be the seventeenth of the Convocation Week meetings. The presence of war students at Johns Hopkins University and the necessary return to their home institutions of those taking part in the program has compelled a change from the normal dates.

The opening general session will be held on Thursday evening, December 26, in McCoy Hall, located at 311 West Monument Street. After a short address of welcome by Dr. Goodnow, president of the Johns Hopkins University, followed by general announcements concerning the meetings, the retiring president of the association, Dr. Theodore W. Richards, of Harvard, will deliver his address on "The conservation of the world's resources."

Regular meetings of the Sections of the Association will be held from Thursday morning to Saturday afternoon. The addresses of the retiring vice-presidents, to be delivered on those days, are as follows:

Section A.—Henry Norris Russell. "Variable stars."

Section B.—William J. Humphreys. "Some recent contributions to the physics of the air."

Section C.—William A. Noyes. "Valence."

Section D.—Henry Sturgis Drinker. "The need of conservation of our vital and natural resources as emphasized by the lessons of the war."

Section E.—George Henry Perkins. "Vermont physiography."

Section F.—Herbert Osborn. "Zoological aims and opportunities."

Section G.—Burton E. Livingston. "Some responsibilities of botanical science."

Section H.—Edward L. Thorndike. "Scientific personnel work in the United States army."

Section I.—George Walbridge Perkins. (No address—in France.)

Section K.—C.-E. A. Winslow. (No address—section not meeting.)

Section L.—Edward Franklin Buchner. "Scientific contributions of the educational survey."

Section M.—Henry Jackson Waters. "The farmers' gain from the war."

The registration headquarters will be in the lobby at the main entrance of Gilman Hall and will open on Thursday, December 26, and succeeding days at 9 A.M. Arrangements will probably be made to attend to the registration of those who call after 4 P.M. on Wednesday at the Assistant Secretary's office in the Southern Hotel. All of the meetings will be held in the new buildings of the Johns Hopkins University at Homewood. The Baltimore City College, downtown, may be used by one of the sections. The council will meet on Friday and Saturday mornings at 9 o'clock at Gilman Hall. The meeting of the general committee for the election of officers for next year and for the selection of the time and place of the next meeting will be held at the Southern

Hotel at 10 o'clock on Friday evening, December 27. The several sections of the Association will hold their sessions for the nomination of officers and the transaction of other business on the call of the chairman, in most cases just before or just after the address of the retiring vice-president.

It is expected that there will be a number of joint meetings and the usual smokers and dinners and meetings of specific societies and groups. Among these, may be mentioned the symposium of the Geological Society of America, the Association of American Geographers and Section E on the Relations of Geology to the War. The Geological Society will hold a smoker on Friday night and its annual dinner on Saturday night, followed by the address of its retiring president. The American Society of Naturalists will hold its usual dinner on Saturday night, followed by an address by Dr. Vernon L. Kellogg on "The German philosophy of war." Section F, on Saturday afternoon, will hold a general conference between governmental and laboratory zoologists. The American Association of Economic Entomologists will have a program giving particular prominence to the insect problems that are vital in connection with war activities. The Botanical Society of America, with the American Phytopathological Society, will hold a symposium on Our Present Duty as Botanists. The Botanists' annual dinner will be held on Friday night. The American Phytopathological Society will hold its tenth anniversary dinner on Wednesday night.

Baltimore hotels are:

Southern Hotel—Association Headquarters, Light and German Streets.

Emerson—Baltimore and Calvert Streets.

Belvedere—Charles and Chase Streets.

Rennert—Liberty and Saratoga Streets.

Stafford—Charles and Madison Streets.

Caswell—Baltimore and Hanover Streets.

New Howard—Howard and Baltimore Streets.

Altamont—Eutaw Place and Lanvale Street.

Eutaw Hotel—Eutaw and Fayette Streets.

Waldorf—Charles Street and North Avenue.

Reservations should be made well in advance, but it is not anticipated that persons in attendance will be unduly hampered in finding quarters. Camps Holabird and Meade are in proximity of Baltimore, it is true, and the hotels have been previously crowded by the wives and families of the Army men stationed at these camps; but this condition, it is thought, will be somewhat alleviated. For the convenience of members who prefer room and board in private residences in proximity to the meeting-places at the university, the association has been fortunate in securing the services, through the courtesy of President Goodnow, of a librarian of the Johns Hopkins University for the handling of such details as would regularly devolve upon the local committee. This librarian, Miss L. M. Bollman, is now advertising for rooms in private residences and is asking for rates on (1) room with board, (2) room without board, and (3) board only, the latter for the convenience of those members who are located downtown but wish to dine in proximity to the university. Miss Bollman will maintain a list, available to members of the American Association and the affiliated societies, of all accommodations listed under the above three headings.

Members of the association and the affiliated societies will, doubtless, realize that a reduction on railway fares is not practicable at a critical time such as this. The assistant secretary, at the time of his interview with the United States Railroad Administration, was assured that the only exceptions to this policy were in the cases of the gatherings of the veterans of the Civil and Spanish wars and of the State Agricultural Fairs, the latter having precedence because of the need of stimulating food production.

The following affiliated societies have indicated their intention to meet in Baltimore during Convocation Week:

American Federation of Teachers of the Mathematical and the Natural Sciences.—Will meet on date to be announced. Secretary, William A. Hedrick, Central High School, Washington, D. C.

American Physical Society.—Will hold joint sessions with Section B, A. A. A. S., on dates

to be announced. President, H. A. Bumstead. Secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

Optical Society of America.—Will meet on Friday, December 27. President, F. E. Wright. Secretary, P. G. Nutting, Westinghouse Research Laboratory, East Pittsburgh, Pa.

Society for Promotion of Engineering Education.—Will meet on date to be announced. President, John F. Hayford. Secretary F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

Geological Society of America.—Will meet on Friday and Saturday, December 27 and 28. Joint meeting with Association of American Geographers, afternoon of December 28; joint meeting with Section E, A. A. A. S., on night of December 28. President, Whitman Cross. Secretary, E. O. Hovey, American Museum of Natural History, New York, N. Y.

Association of American Geographers.—Will meet on Friday and Saturday, December 27 and 28. Joint meeting with the Geological Society of America on the afternoon of December 28. President, Nevin M. Fenneman, 3755 Broadway, New York, N. Y. Secretary, O. L. Fassig (absent).

Paleontological Society of America.—Will meet on Saturday, December 28. President, F. H. Knowlton. Secretary, R. S. Bassler, U. S. National Museum, Washington, D. C.

American Society of Naturalists.—Will meet Saturday morning, December 28. Annual dinner, Saturday night. Secretary, Bradley M. Davis, Statistical Division, U. S. Food Administration, Washington, D. C.

American Society of Zoologists.—Will meet on Thursday, Friday and Saturday, December 26 to 28. Joint session with American Society of Naturalists Saturday morning, December 28. President, George Lefevre. Acting Secretary, W. C. Allee, Lake Forest College, Lake Forest, Ill.

American Association of Economic Entomologists.—Will meet Thursday and Friday, December 26 and 27. President, E. D. Ball. Secretary, Albert F. Burgess, Gipsy Moth Laboratory, Melrose Highlands, Mass.

Botanical Society of America.—Will meet on Thursday to Saturday, December 26 to 28. Joint sessions with Section G, A. A. A. S., and American Phytopathological Society on Thursday afternoon, December 26. Joint sessions with American Phytopathological Society on Friday and Saturday, December 27 and 28. Joint session with Ecological Society of America on Saturday morning, December 28. President, William Trelease. Secretary, J. R. Schramm, Cornell University, Ithaca, N. Y.

American Phytopathological Society.—Will meet from Monday to Saturday, December 23 to 28. Joint meetings with Botanical Society of America on Friday and Saturday, December 27 and 28. Tenth anniversary dinner, 6:30 P.M., Wednesday, December 25. President, Mel. T. Cook. Secretary, C. L. Shear, U. S. Department of Agriculture, Washington, D. C.

Ecological Society of America.—Joint session with Botanical Society of America on Saturday morning, December 28. Dates of other sessions to be announced. President, Henry C. Cowles. Secretary, Forrest Shreve, Desert Laboratory, Tucson, Arizona.

American Anthropological Association.—Will hold joint meetings with Section H, A. A. A. S., and American Folk-Lore Society on Friday and Saturday, December 27 and 28. President, A. L. Kroeber. Acting Secretary, Bruce W. Merwin, University of Pennsylvania Museum, Philadelphia, Pa.

American Folk-Lore Society.—Will hold joint session with American Anthropological Association on Friday, December 27. President, C. Marius Barbeau. Secretary, Charles Peabody, Harvard University, Cambridge, Mass.

American Metric Association.—Will meet on Friday and Saturday, December 27 to 28. The session of Saturday will be held at the Bureau of Standards, Washington. President, George F. Kunz. Secretary, Howard Richards, Jr., 156 Fifth Avenue, New York, N. Y.

American Society for Horticultural Science.—Will meet on Friday and Saturday, December 27 and 28. President, C. A. McCue. Secretary, C. P. Close, College Park, Md.

Society of American Foresters.—Will meet on Friday and Saturday, December 27 and 28. President, Filibert Roth. Secretary, E. R. Hodson, U. S. Forest Service, Washington, D. C.

School Garden Association of America.—Will meet on dates to be announced. President, J. H. Francis. Acting Secretary, V. E. Kilpatrick, 124 West 30th St., New York, N. Y.

The officers for the Baltimore meeting are:

President—John Merle Coulter, University of Chicago, Chicago, Ill.

Vice-Presidents—A (Mathematics and Astronomy): George D. Birkhoff, Harvard University, Cambridge, Mass. B (Physics): Gordon F. Hull, Dartmouth College, Hanover, N. H. C (Chemistry): Alexander Smith, Columbia University, New York. D (Engineering): Ira N. Hollis, Worcester Polytechnic Institute, Worcester, Mass. E (Geology and Geography): David White, U. S. Geological Survey, Washington, D. C. F (Zoology): William Patten, Dartmouth College, Hanover, N. H. G (Botany): A. F. Blakeslee, Cold Spring Harbor, N. Y. H (Anthropology and Psychology): Aleš Hrdlička, U. S. National Museum, Washington, D. C. I (Social and Economic Science): John Barrett, Pan American Union, Washington, D. C. K (Physiology and Experimental Medicine): Frederic S. Lee, Columbia University, New York. L (Education): Stuart A. Courtis, Department of Educational Research, Detroit, Mich. M (Agriculture): Henry P. Armsby, State College, Pa.

Permanent Secretary—L. O. Howard, Smithsonian Institution, Washington, D. C.

General Secretary—O. E. Jennings, Carnegie Museum, Pittsburgh, Pa.

Secretary of the Council—(No election).

Secretaries of the Sections—A (Mathematics and Astronomy): Forest R. Moulton, University of Chicago, Chicago, Ill. B (Physics): George W. Stewart, State University of Iowa, Iowa City, Iowa. C (Chemistry): Arthur A. Blanchard, Massachusetts Institute of Technology, Cambridge, Mass. D (Engineering): F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa. E (Geology and Geography): Rollin T. Chamberlin, University of Chicago, Chicago, Ill. F (Zoology): W. C. Allee, Lake Forest College, Lake Forest, Ill., in absence of Herbert V. Neal. G (Botany): Mel T. Cook, Agricultural Experiment Station, New Brunswick, N. J. H (Anthropology and Psychology): E. K. Strong, Jr., 1821 Adams Mill Road, Washington, D. C. I (Social and Economic Science): Seymour C. Loomis, 82 Church Street, New Haven, Conn. K (Physiology and Experimental Medicine): A. J. Goldfarb, College of the City of New York, New York, N. Y. L (Education): Bird T. Baldwin, Walter Reed General Hospital, Washington, D. C. M (Agriculture): Edwin W. Allen, U. S. Department of Agriculture, Washington, D. C.

Treasurer—R. S. Woodward, Carnegie Institution of Washington, Washington, D. C.

Assistant Secretary—F. S. Hazard, Office of the A. A. A. S., Smithsonian Institution, Washington, D. C.

SCIENTIFIC EVENTS

A JOURNEY ROUND THE ARCTIC COAST OF ALASKA

A letter written by Archdeacon Stuck, at Fort Yukon, Alaska, in June of this year, describing a journey made by him last winter round the whole Arctic coast of Alaska, is abstracted in the *British Geographical Journal*. The journey, which naturally involved no small amount of hardship, afforded an unrivalled opportunity for gaining acquaintance with the Eskimo throughout the great stretch of country traversed, as well as for a comparative study of the work carried on among them by the various Christian organizations busy in that remote region. These Eskimo, the writer says, are "surely of all primitive peoples the one that has the greatest claim to the generous consideration of civilized mankind. Where else shall a people be found so brave, so hardy, so industrious, so kindly, and withal so cheerful and content, inhabiting such utterly naked country lashed by such constant ferocity of weather?" Everywhere he received from them

the greatest possible help and kindness, and brought away the warmest feeling of admiration and friendship. The start was made on the west coast first made known to the world by Cook and Kotzebue, Beechey, Collinson and Bedford Pim, and here it was possible to find some habitation, usually an underground igloo, on every night but one of the journey. Storms were encountered, but there were commonly fair winds and there were no special hardships, traveling being far more rapid than is usual in the interior. At Point Barrow a halt of two weeks gave opportunity for the study of the largest Eskimo village in Alaska. In spite of the advancing season the difficulties increased with the resumption of travel, March being the month in which the severest weather is to be expected here. Throughout the 250 miles to Flaxman Island the party saw only one human being and were housed only twice. "It is," says the writer, "the barrenest, most desolate, most forsaken coast I have ever seen in my life: flat as this paper on which I write, the frozen land merging indistinguishably into the frozen sea; nothing but a stick of driftwood here and there, half buried in the indented snow, gives evidence of the shore." The fortnight's travel along this stretch was a constant struggle against a bitter northeast wind with the thermometer 20° to 30° below zero Fahrenheit, and at night, warmed only by the "primus" oil cooking stove, the air within their little snow house was as low as from 48° to 51° below zero. The almost ceaseless wind was a torment, and the faces of all were continually frozen. There are Eskimo on the rivers away from the coast, but it was impossible to visit them. East of Point Barrow all the dog-feed had to be hauled on the sledge, and—for the first time since the archdeacon had driven dogs—they occasionally went hungry when there was no driftwood to cook with. The heaviest task however came on the journey inland to Fort Yukon. Beyond the mountains the winter's snow lay unbroken, and for eight days a trail down the Collen River had to be beaten ahead of the dogs. At the confluence of the Collen with the Porcupine Stefánsson and his party were met with, escorted on the way to Fort Yukon by Dr. Burke, of the hospital there. Stefánsson had lain ill all the winter at Herschel Island, and would never have recovered had he not finally resolved to be hauled 400 miles to the nearest doctor.

A PROPOSED BRITISH INSTITUTE OF INDUSTRIAL ART

WE learn from the London *Times* that the British Board of Trade in conjunction with the Board of Education and with the advice of representative members of the Royal Society of Arts, the Arts and Crafts Exhibition Society, the Art Workers' Guild, the Design and Industries Association, and various persons and organizations connected with manufacture and commerce, have framed a scheme for the establishment of a British Institute of Industrial Art, with the object of raising and maintaining the standard of design and workmanship of works and industrial art produced by British designers, craftsmen and manufacturers, and of stimulating the demand for such works as reach a high standard of excellence.

The institute will be incorporated under the joint auspices of the Board of Trade as the department dealing with industry and the Board of Education as the authority controlling the Victoria and Albert Museum, and the methods by which it is proposed to achieve its objects include:

(*a*) A permanent exhibition in London of modern British works selected as reaching a high standard of artistic craftsmanship and manufacture.

(*b*) A selling agency attached to this exhibition.

(*c*) A purchase fund for securing for the state selected works of outstanding merit exhibited at the institute.

(*d*) The establishment of machinery for bringing designers and art workers into closer touch with manufacturers, distributors and others.

(*e*) The organization of provincial and traveling exhibition of a similar character, either directly or in cooperation with other organizations.

It is not at present intended that the exhibition of the institute shall be actually opened

until after the war, but all preparatory steps are being taken so as to avoid delay when peace has been restored. There is reason to hope that within a short period of years the institute may become self-supporting (except, of course, as regards the cost of purchasing for the nation selected works of outstanding merit). But it is necessary to provide for an adequate guarantee fund to ensure the stability of the scheme, at least during its initial stages, and thus to enable a high standard to be rigorously maintained without regard to immediate financial necessities. The Board of Trade confidently hope that such a guarantee fund will be forthcoming.

AGRICULTURE AND THE GOVERNMENT[1]

In the field of agriculture we have agencies and instrumentalities, fortunately, such as no other government in the world can show. The Department of Agriculture is undoubtedly the greatest practical and scientific agricultural organization in the world. Its total annual budget of $46,000,000 has been increased during the last four years more than 72 per cent. It has a staff of 18,000, including a large number of highly trained experts, and alongside of it stand the unique land grant colleges, which are without example elsewhere, and the 69 state and federal experiment stations. These colleges and experiment stations have a total endowment of plant and equipment of $172,000,000 and an income of more than $35,000,000 with 10,271 teachers, a resident student body of 125,000, and a vast additional number receiving instructions at their homes. Country agents, joint officers of the Department of Agriculture and of the college, are everywhere cooperating with the farmers and assisting them. The number of extension workers under the Smith-Lever Act under the recent emergency legislation has grown to 5,500 men and women working regularly in the various communities and taking to the farmer the latest scientific and practical information. Alongside these great public agencies stand the very effective voluntary organizations among the farmers themselves which are more and more learning the best methods of cooperation and the best methods of putting to practical use the assistance derived from governmental sources. The banking legislation of the last two or three years has given the farmers access to the great lendable capital of the country, and it has become the duty of both of the men in charge of the Federal Reserve Banking System and of the Farm Loan Banking System to see to it that the farmers obtain the credit, both short term and long term, to which they are entitled not only, but which it is imperatively necessary should be extended to them if the present tasks of the country are to be adequately performed. Both by direct purchase of nitrates and by the establishment of plants to produce nitrates, the government is doing its utmost to assist in the problem of fertilization. The Department of Agriculture and other agencies are actively assisting the farmers to locate, safeguard and secure at cost an adequate supply of sound seed. The Department has $2,500,000 available for this purpose now and has asked the Congress for $6,000,000 more.

[1] From President Wilson's Message to Farmers' Conference at Urbana, Ill., January 31 ,1918.

USE OF THE METRIC SYSTEM IN THE UNITED STATES[1]

More extensive use of the metric system in the trade and commerce of the United States is recommended in a resolution adopted by the United States section of the International High Commission, of which Secretary McAdoo is chairman.

The commission has regarded this subject as of particular importance in the United States. It is, of course, unnecessary for the United States section to recommend to the Latin-American sections of the commission anything in connection with the metric system, which is exclusively in use throughout Latin America. One of the main obstacles to documentary uniformity as between the United States and Latin America is to be found in the fact that the United States does not make the use of the metric system obligatory, and consequently its consular documents have to

[1] Publication authorized by the Treasury Department.

allow the use of that system merely as optical. Any uniform system of classifying merchandise, however, will require on the part of the United States thoroughgoing and complete adherence to the metric system.

Of more importance than statistical and administrative questions is the use of the metric system in trade. Now that the United States is obviously being drawn into closer and more vital commercial relations by the rest of the world, and particularly with Latin-America, our manufacturers and exporters will be obliged to meet the demands of their prospective customers in a somewhat more accommodating frame of mind than hitherto. Only the English-speaking nations still have to adopt the metric system of weights and measures, and among them the British Empire, or at least Great Britain, seems to be giving serious consideration to the necessity of making a change. Those who read the Commerce Reports of the United States Department of Commerce know how numerous are the opportunities necessarily allowed to pass by because of our inability to supply goods and machinery constructed in accordance with the metric system. The subject has now assumed a most practical character in the minds of those who are planning for post-war trade expansion.

The resolution adopted by the commission is as follows:

The United States section of the International High Commission, having in view the present efforts to bring about the exclusive use of the metric system of weights and measures within the jurisdiction of the United States, resolves:

I. That in the opinion of the section the adoption of that system would be productive of great advantage in the commercial relations of the United States with the other American republics.

II. That the secretary of the section be directed to communicate a copy of this resolution to the chairman of the proper committees of the Senate and the House of Representatives.

AN ECOLOGICAL SURVEY OF THE PALISADES INTERSTATE PARK

Last spring a cooperative ecological survey of the Palisades Interstate Park was established by the commissioners of the Park and the department of forest zoology of The New York State College of Forestry at Syracuse. The park is a large area of about 30,000 acres under the management of joint commissioners representing the states of New York and New Jersey. The park lies along the lower Hudson, including most of the scenic portion of the Palisades, on the west bank of the Hudson, and a relatively large area (the Harriman section) south and west of West Point, in the low wooded mountains of the Hudson Highlands.

This survey is intended to relate the wild life of the park to its numerous visitors, of which during the season just closed there have been about 48,000 campers, who averaged ten days each. Investigations of the birds have been made by Professor P. M. Silloway; the plankton organisms by Dr. Gilbert M. Smith and the fish by Dr. Chas. C. Adams and Professor T. L. Hankinson, assisted by A. E. Fivaz. The first season's field work has been completed and publications on the survey are in preparation from the standpoint of park utilization. The birds have been studied from an educational and recreational, as well as an ecological, point of view. The plankton for its bearing upon the problem of drinking water needed in the park, the fish, and the bathing facilities. The fish have been studied from the standpoint of food, education and recreation. The water storage area has been greatly increased by dams, creating and enlarging ponds and reservoirs. A system of management for these waters and the streams is to be worked out in harmony with the aims of the park.

Those in immediate charge of the work are Mr. Edward F. Brown, manager of the camp department of the park, and Dr. Charles C. Adams, forest zoologist of the college. This is the first comprehensive ecological survey systematically conducted and intended to relate primarily the wild life forest resources of a large public park to the educational, recreational, scientific and economic activities of the park. Many of the problems are the same

general character as those of our national parks. It will require several years to complete the plans now under way. Only the more urgent problems were begun this season. This survey has the hearty support of Mr. George W. Perkins, president of the Park Commissioners, and Dean F. F. Moon, of the College of Forestry.

SCIENTIFIC NOTES AND NEWS

THE Société Médicale des Hôpitaux de Paris elected at a recent meeting, as corresponding members: Dr. Alexander Lambert, the president-elect of the American Medical Association, director of the medical service of the American Red Cross in France; Colonel James T. Case, editor of the *American Journal of Radiology* and chief of the radiologic service of the American Army in France; Professor William S. Thayer of Johns Hopkins, consultant to the American Expeditionary Force; Professor Morton Prince of Tufts College; Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research, and Professor Beverley Robinson of the University and Bellevue Hospital, New York, a former intern of the Paris hospitals. At the same time, five British physicians were also elected, Sir Almroth Wright, Sir Bertrand Dawson, Sir Thomas Barlow, Sir Dyce Duckworth and Sir William Leishman.

WE learn from the *Journal* of the Washington Academy of Sciences that among those at the Bureau of Standards are: Dr. F. W. McNair, president of the Michigan School of Mines, working on airplane engine problems; Dr. C. Nussbaum, formerly instructor in physics at Harvard University, engaged in the study of aeronautic instruments; Mr. E. P. Peck, formerly superintendent of operation of the Georgia Railway and Power Company, assisting in the standardization of electrical apparatus, and Lieutenant Henri Cretien, of the French army, who has been engaged in research work in military problems related to optics.

PROFESSOR G. F. HULL, of Dartmouth College, has been commissioned a major in the Ordnance Department, and is now in Washington.

DR. WILLIAM H. ROSS, of the Bureau of Soils, has been commissioned a captain in the Chemical Warfare Service, and has been assigned to the Edgewood Arsenal, Edgewood, Maryland.

PROFESSOR ROSWELL P. ANGIER, of Yale University, is a captain in the Sanitary Corps, National Army, at the Hazelhurst Field Medical Research Laboratory, Mineola, L. I. He has been engaged in research work on psychological tests for aviators and in instructing other psychologists to give, at other aviation fields of the country, tests already devised.

MR. B. H. RAWL, chief of the Dairy Division of the Bureau of Animal Industry since 1909, has been appointed assistant chief of the bureau.

IN the U. S. National Museum Dr. Charles W. Richmond has been promoted to be associate curator of birds. Mr. Bradshaw H. Swales has been appointed honorary curator of birds' eggs.

PROFESSOR C. D. CHILD, head of the department of physics at Colgate University, is spending the current college year at Cornell University, engaged in special government research.

LIEUTENANT GEORGE O. FERGUSON, JR., associate professor of psychology at Colgate University, is stationed at Camp Lee, Virginia, in charge of the psychological examination of men in that camp.

DR. THOMAS P. MCCUTCHEON, associate professor of chemistry of the University of Pennsylvania, has been assigned to overseas duty as consultant chemist in connection with the Chemical Warfare Service. Dr. McCutcheon, who is serving in a civilian capacity, spent the entire summer in government service at Washington.

D. FOREST HUNGERFORD, professor of chemistry at the University of Arkansas, has accepted a position with the United States De-

partment of Agriculture, with headquarters at Athens, Ga.

MR. N. A. BENGTSAN has been appointed special representative of the War Trade Board for work in Denmark and expects to leave soon for Copenhagen. During the past summer and autumn he has been commodity expert, in charge of cereal investigations in the Bureau of Research of the War Trade Board. Next autumn Dr. Bengtsan expects to resume the duties of professor of geography at the University of Nebraska.

PROFESSOR HENRY C. COWLES, of the University of Chicago, delivered a lecture at the meeting of the Geographic Society of Chicago on November 8, entitled "Forests and Forest Politics in Illinois," substituting for Mr. Currelly, who is detained in Toronto by illness.

AT the first scientific meeting of the Zoological Society of London for the present session Professor H. M. Lefroy read a paper, illustrated by lantern slides, on the wheat weevil in Australia, which has done so much damage to the stores of the Wheat Commission.

AT a meeting of the New York Section of the American Chemical Society on November 8, the program consisted of fifteen-minute addresses on the subject of an institute for cooperative research by chemists, biologists and manufacturers as an aid in the development of the American drug industry. Addresses were made by Dr. John J. Abel, Johns Hopkins University Medical School (by letter); Dr. P. A. Levene, Rockefeller Institute for Medical Research; Dr. C. L. Alsberg, U. S. Bureau of Chemistry; Dr. A. S. Loevenhart, American University Experiment Station; Dr. F. R. Eldred, Eli Lilly & Co.; Dr. D. W. Jayne, The Barrett Company.

PROFESSOR HENRI L. JOLY has given a course of three public lectures in English on France's share in the progress of science, at University College, London. The first lecture, on October 22, dealt with mathematics, astronomy and physical science; the second, on October 29, with chemistry and the natural sciences, and the third, on November 5, with biology and the medical sciences.

THE annual Thomas Hawksley lecture of the Institution of Mechanical Engineers, London, was delivered in the hall of the Institution of Civil Engineers on October 4, by Dr. W. C. Unwin, who took as his subject "The Experimental Study of the Mechanical Properties of Materials."

THE first annual Streatfield memorial lecture was delivered on October 17, at the City and Guilds Technical College, London, by Professor W. J. Pope, who took as his subject "The future of chemistry."

THE late Dr. Magnan, the French psychiatrist, left $5,000 to the Paris Academy of Medicine, to be applied to the foundation of a triennial prize for the best work on mental medicine.

WE learn from *Nature* that a memorial tablet and medallion of the late Mr. F. W. Rudler, in the quadrangle of the University College of Wales, Aberystwyth, in which Mr. Rudler was one of the earliest professors, 1876–79, was unveiled by Professor J. Mortimer Angus, on October 18. Mr. Rudler attached great value to students' geological excursions, in regard to which he himself rendered devoted service during his membership of the Geologists' Association. A few of his friends are, therefore, desirous of creating a fund to be capitalized, the annual income from which is to be devoted, on the recommendation of the professor of geology, towards the defrayment, where necessary, of the expenses of students during such excursions.

OVER $8,000 has been contributed to the Ramsay Memorial Fund in the United States up to November 1. It is hoped that the American subscription may reach $10,000 by January 1, 1919. Checks should be made payable and sent to the Ramsay Memorial Fund Committee, W. J. Matheson, treasurer, 2 Burling Slip, New York City.

PROFESSOR VOLNEY M. SPALDING, formerly professor of botany in the University of Mich-

igan, died at Loma Linda, California, on November 12, at the age of sixty-nine years.

MR. DOUGLAS C. MABBOTT, biologist of the Biological Survey, U. S. Department of Agriculture, has been killed in action in France, at the age of twenty-five years. He was the author of papers on American wild ducks and their food habits.

WINTHROP D. FOSTER, of the zoological division, U. S. Bureau of Animal Industry, died of pneumonia, on October 6, at Washington, aged thirty-eight years.

CLARENCE SIDNEY VERRILL was lost on the *Princess Sophia,* which was wrecked on October 26, on the coast of British Columbia, with the loss of all on board. He was a mining engineer and was returning from the examination of a gold mine. He was the youngest son of Addison Emery Verrill, professor emeritus of zoology at Yale University.

THE annual meeting of the American Association of Anatomists which is usually held during the Christmas vacation, has been postponed until the spring, and will be held possibly during the Easter recess.

THE council of the American Psychological Association has voted to abandon the annual meeting scheduled for December, 1918. This action seemed advisable in view of the prospect of a very small attendance and many difficulties in the arrangements for the meeting.

PROFESSOR JOHN W. HARSHBERGER has been elected president of the University of Pennsylvania chapter of the Sigma Xi. The program for the session of 1918–19 is as follows:

November 20, The Engineering Departments, University of Pennsylvania, speaker—Professor Robert H. Fernald. "Is Our Fuel Supply nearing Exhaustion?"

January 22, The John Harrison Laboratory of Chemistry. Speakers—Provost Smith and Professor Walter H. Taggart.

March 12, The Psychological Department, College Hall. Speaker—Professor Lightner Witmer.

May 1, Joint Meeting of Phi Beta Kappa and Sigma Xi.

June 11, Gardens of the Zoological Society of Philadelphia. Speaker—Dr. Charles B. Penrose, president of the Zoological Society.

THE meeting of the Connecticut Section of the American Society of Mechanical Engineers was held at Yale University on November 20. At the afternoon session in the Mason Mechanical Engineering Laboratory, Mr. J. Arnold Norcross presided and addresses were made by Mr. C. C. Sibley, plant engineer of the Marlin-Rockwell Corporation, on its new Dixwell Avenue Power Plant, and by Mr. C. E. Libbey, construction engineer, with Hollis French & Allen Hubbard, Boston, Mass., on the new University Central Heating Plant on Ashmun Street. At the evening session at 7.30 in Lampson Lyceum there was a joint meeting with the United States Naval Unit. Professor Breckenridge presided and an illustrated address was given by Mr. W. H. Blood, of the American International Shipbuilding Corporation, Philadelphia, Pa., on "The Building of the Hog Island Shipyard."

THE Madrid correspondent of the *Journal of the American Medical Association* writes that Dr. Gomez Casas, physician of the Almeira prison, reported to his superiors the presence of influenza among the inmates of the prison early in the first epidemic. The governor of Almeira was not pleased at having his province invaded by the disease, and he summoned Dr. Casas and ordered him to sign a written report to the effect that he had been mistaken in his diagnosis, and retract his statements as to the existence of influenza in the prison. The Colegio Medico publicly announced that it would stand by Dr. Casas and subscribe the amount to pay the fine which a governor ignorant of his duties had imposed on him. At the same time an official protest was filed with the central public health authorities.

THE Ordnance Department of the Army, particularly in the production and Inspection Divisions, is in need of men with training in the manufacture of explosives and the related raw materials. The manufacture of explosives is developing out of proportion to the number of men in the country who have had training and experience in that work. To meet this condition the War Department Committee on

Education and special training is establishing in the department of chemical engineering at Columbia University in the City of New York an Ordnance Department School of Explosives Manufacture. The object of this school is to give men with proper preliminary qualifications the training necessary to fit them for use by the Ordnance Department as commissioned officers in the supervision of factory operation and inspection of the finished products in plants manufacturing explosives and raw materials for explosives. The school will be only for enlisted men in the military service who are detailed for instruction in the school by the Ordnance Department.

UNIVERSITY AND EDUCATIONAL NEWS

THE will of the late Dr. John C. McClenathan, Connellsville, the value of whose estate is approximately $160,000, leaves the bulk, after the death of his widow, to Washington and Jefferson Colleges to erect a building to be known as the McClenathan Hall of Science.

THE Loyola University School of Medicine has recently been reorganized. The buildings and equipment of the Chicago College of Medicine and Surgery were purchased in September, 1917, making an important addition to the resources of the school. In the department of anatomy Dr. R. M. Strong, professor of anatomy at Vanderbilt University Medical School has been appointed professor and head. Dr. Thesle T. Job has been made assistant professor of anatomy.

AT Cornell University Mrs. Dorothy Russell Naylor, '13, has been appointed instructor in mathematics in place of Percy A. Fraleigh, '17, who has received leave of absence for National service. Frances G. Wick, '05, has been appointed acting assistant professor of physics for the current year.

DR. S. D. ZELDIN, of the College of Hawaii, has been appointed professor of mathematics in Olivet College.

DR. HORACE LEONARD HOWES has been appointed professor of physics at the New Hampshire College to succeed Professor V. A. Suydam, resigned. He is a graduate of Syracuse University in the class of 1905 and took his doctor's degree at Cornell in 1915. While at Cornell he was instructor in physics and research assistant to Professors E. L. Nichols and Ernest Merritt.

DISCUSSION AND CORRESPONDENCE

FOOD OF AQUATIC HEMIPTERA

THE reading of an interesting article in this JOURNAL by Hungerford,[1] that discussed the food supply of certain aquatic bugs, caused me to look up some of my own notes on the food of water-striders and other aquatic Hemiptera. These notes were recorded mainly from observations made near Urbana, Ill., during the years 1911–13 inclusive.

Hungerford[2] states: "In the literature dealing with aquatic Hemiptera, we are informed that without exception they are predatory: those which dwell upon the surface capturing such flies and other terrestrial insects as may chance to fall into the water, and those that pass their lives beneath the surface preying upon aquatic insects and similar organisms." My own conclusions, regarding the food of water bugs, formed from reading the literature on aquatic Hemiptera, if expressed briefly, would be very similar to those just quoted, with some exceptions.

At the present, I recall three writers who mention that aquatic bugs use other food besides insects. Miall[3] makes the following statement: "To this suborder [Heteroptera] belong a number of very common aquatic insects. They are all predatory, feeding upon small insects or crustaceans." This writer[4] points out that, "Nepa feeds mostly on small insects, Ranatra, upon the water-flea (Daphnia) and other aquatic animals." The following is another quotation from Miall:[5] The in-

[1] "Notes Concerning the Food Supply of Some Water Bugs," SCIENCE, N. S., Vol. XLV., pp. 336–337, 1917.

[2] *Ibid.*, p. 336.

[3] "The Natural History of Aquatic Insects," London, 1903, p. 346.

[4] *Ibid.*, p. 354.

sects in question are *Halobates* and *Halobatodes*. . . . They feed upon the floating bodies of dead marine animals, and may be seen to run out from such objects when alarmed by the approach of a boat. These insects belong to the Rhynchota (Hemiptera) and in some respects come pretty near to such forms as Hydrometra or Velia." Walker[6] has found once or twice several specimens of marine Hemiptera belonging to the group *Halobates*, gathered round floating pieces of seaweed, as if obtaining nutriment. However, it must be acknowledged, that practically nothing is known about the food of these creatures. McCook[7] has demonstrated that individuals of *Gerris remigis* feed readily on the juice "of finely ground boiled beef." They take such food, with avidity, even in their own habitat.

If a more critical study should be made of the food of aquatic bugs in general, in their various habitats, I believe that still further evidence would be accumulated, showing that considerable food, of the other kinds, besides insects, was used by these interesting forms. In fact Hungerford[8] himself has pointed out a number of exceptions, some of which I can substantiate from my own observations, and to which I can add others also from my own observations.

The following statements agree with those of Hungerford[9] to the extent that the aquatic bugs now to be mentioned, are not entirely predatory, nor is their food entirely that of insects: I have found by microscopic examination of the alimentary system that water-boatmen of the genus *Arctocorisa* feed on vegetable matter; diatoms and Oscillatoria have been identified. They probably obtain most of this from the ooze on the surface of the mud, at the bottom of the pond or stream. In order to obtain additional evidence, I placed some of the water-boatmen in shallow, glass dishes of water, with some of the ooze containing algal débris, as suggested by Hungerford,[10] but my observations were discontinued before I was satisfied definitely that these bugs scooped up this substance with their front legs, and used it as food. I also placed back-swimmers of the genus *Notonecta* in shallow, glass dishes of water and fed them with small crustaceans, such as copepods and ostrocods. The back-swimmers appeared to thrive on this food. By means of a similar experiment, I was able to demonstrate that the marsh-treader, *Hydrometra martini*, will feed on copepods tangled in the surface-film. This was more likely to occur when the water became somewhat stale.

It is well known that many members of the family Gerridæ, which consists of an assemblage of aquatic Hemiptera living on the water-film, feed mainly on terrestrial insects which fall into the water and float on its surface. Water-striders are considered to be entirely predatory in their manner of feeding, and so far as I know there is no statement to the contrary in the literature on aquatic Hemiptera. However, it may be of interest to state that I have definite proof that *Gerris remigis* and *Gerris marginatus* both feed, at times, on vegetable matter. The following statement is a modified extract, taken from my field notes: After having studied water-striders in their natural habitats for several months, especially with reference to their food relations, I decided that both *Gerris remigis* and *Gerris marginatus* were entirely flesh-eating. However, on October 14, 1911, this opinion was changed. At the time, I was making observations of the water-striders on the surface-film of a brook near Whiteheath, which is approximately eighteen miles southwest of Urbana. Small red fruits were observed, drifting downstream, and these attracted the attention of the water-striders at once. Both species seized them readily, *Gerris remigis* with the greater avidity, and pushed their beak-like mouth-parts through the outer skin, down into the inner fruit. Some of the fruits, with their attendant water-striders, drifted near the bank of the

[5] *Ibid.*, pp. 380–381.

[6] "On the Genus *Halobates* Esch., and Other Marine Hemiptera," *Entomologist's Monthly Magazine*, Second Series, Vol. IV., p. 231, 1893.

[7] "Nature's Craftsmen," New York, 1907, pp. 363–365.

[8] *Loc. cit.*, pp. 336–337.

[9] *Ibid.*

[10] *Loc. cit.*, p. 337.

stream, and with the aid of a large reading-glass attached to a pole, it was possible to see the feeding movements of the mouth-parts. Several observations were recorded later than this of specimens of *Gerris remigis* sucking the juices of these berries. Only on one other occasion was *Gerris marginatus* seen to use this fruit as food. The plant from which these fruits came is commonly known as the coral-berry or Indian currant, *Symphoricarpos vulgaris*. It is very common along the banks of the brook near Whiteheath.

I have found that, during my observations of the food habits of water-striders in captivity, while confined in aquaria, both species mentioned suck the juices of freshly killed *Physa* and *Planorbis*. They also feed on fresh beef, on the soft parts of banana fruit, and on the inner, softer parts of the skin.

These observations seem to add additional evidence to Hungerford's[11] contention that aquatic Hemiptera are neither entirely predacious, nor do they feed entirely upon insects. It is very likely that other observers could report further observations of the character that have been recorded here.

C. F. CURTIS RILEY
THE NEW YORK STATE COLLEGE OF FORESTRY,
AT SYRACUSE UNIVERSITY,
SYRACUSE, NEW YORK

[11] *Loc. cit.*, pp. 336–337.

SCIENTIFIC BOOKS

Wild Animals of North America: Intimate Studies of Big and Little Creatures of the Mammal Kingdom. By EDWARD W. NELSON. Natural-Color Portraits from Paintings by LOUIS AGASSIZ FUERTES. Track Sketches by ERNEST THOMPSON SETON. Published by the National Geographic Society, Washington, D. C., U. S. A.; 8vo, pp. + 385–612, folded frontispiece, 108 colored illustrations on text paper (not plates), 85 halftone illustrations. [This is essentially a reprint of two articles which appeared in the *National Geographic Magazine*, for November, 1916, and May, 1918. The changes comprise repaging beyond page 472, the readjustment of the matter on pages 473–475, the replacement of a half-tone on page 475, the rectification of page references to illustrations to accord with the new paging where needed, and readjustment of the matter from page 571 on, so as to admit 32 new illustrations of footprints and the captions to these.]

This is a work which meets to a gratifying degree the need for an essentially non-technical treatise upon the natural history of the mammals of North America. No living person is better equipped to carry to a successful conclusion such an undertaking than is its author. Nelson has contributed in the field of vertebrate zoology now for over forty years, to be explicit, beginning in July, 1876 (*Bulletin Nuttall Ornithological Club*, Vol. 1, p. 39). With a background of long experience in the field, and with further years of official connection with the United States Biological Survey and its unique resources in mammalogy, he has made available a brochure of pleasing amplitude and satisfying authoritativeness.

Between the colored pictures and the written sketches the public can gain from this contribution a better idea of our principal mammals than from any other available publication. It should awaken a generally greater interest in our native mammals, and this will help build up a desire for the conservation of the harmless and useful species such as has resulted from the public education in relation to our bird life. On the other hand it is important to be able to distinguish those mammals, chiefly of the order Rodentia, which are thoroughly inimical to human interests. People at large must know how to cope with these enemies. It would seem that a full knowledge of the natural history of such animals is essential to determining the most successful means of controlling them and to applying these means properly to the varying conditions throughout the country. Nelson's accounts of our injurious mammals are full of stimulative suggestions along these lines, and while the work as a whole can not be considered as an "economic" publication, its influence will go far to secure adequate popular consideration of these matters.

The species are taken up in groups, in so far as this can be done safely. Each biography, of which there are 119, is, as a rule, a composite applying to a number of near-related forms, thus simplifying matters of presentation, and avoiding repetition. A marked feature of the book is the degree of concentration attained; there is no trace of padding, and no room for baseless speculation, sentimentalizing or humanizing, such as characterize many current "nature" books. At the same time the style is animated and thoroughly entertaining, a gift of composition which Nelson has exercised in many preceding contributions. Here is an instance, unfortunately a rare one, in which a man who really knows the field has put out a popular book on a natural history subject.

Many are the portrayals which are evidently based on Nelson's own personal field knowledge, some of them involving facts here for the first time made known to science. His account of the behavior of kangaroo rats in Lower California is particularly apt in illustration of the above statement.

> During several nights I passed hours watching at close range the habits of these curious animals. As I sat quietly on a mess box in their midst . . . [they] would forage all about with swift gliding movements, repeatedly running across my bare feet. Any sudden movement startled them and all would dart away for a moment, but quickly return. . . . They were so intent on the food [grains of rice put out for them] that at times I had no difficulty in reaching slowly down and closing my hand over their backs. I did this dozens of times, and after a slight struggle they always became quiet until again placed on the ground, when they at once renewed their search for food as though no interruption had occurred. . . . While occupied in this rivalry for food they became surprisingly pugnacious. If one was working at the rice pile and another rat or a pocket mouse approached, it immediately darted at the intruder and drove it away. The mode of attack was to rush at an intruder and, leaping upon its back, give a vigorous downward kick with its strong hind feet. . . . Sometimes an intruder, bolder than the others, would run only two or three yards and then suddenly turn and face the pursuer, sitting up on its hind feet like a little kangaroo. The pursuer at once assumed the same nearly upright position, with its fore feet close to its breast. Both would then begin to hop about watching for an opening. Suddenly one would leap at the other, striking with its hind feet, . . . [producing] a distinct little thump and the victim rolled over on the ground. After receiving two or three kicks the weaker of the combatants would run away. The thump made by the kick when they were fighting solved the mystery which had covered this sound heard repeatedly during my nights at this camp.

The brilliantly coated paper used throughout this book although hard on sensitive eyes, is necessary to the handling of the halftone illustrations. The printing of both the colored and uncolored pictures in all the copies we have seen has been done with pronounced success. The color drawings by Fuertes are admirable and we are astonished at the success with which this noted bird artist was able to turn to mammals, the drawings of which in this contribution mark as far as we know his first efforts in the new field.

A critical reviewer might succeed in finding a number of small points to elaborate upon and of which to complain. For instance: It is trite to say that an Alaska brown bear is no more an *animal* than is a house fly. Yet here we have the title, "Wild Animals of North America," though there is an evident effort made in the subtitle to remedy the matter by using the expression, "*mammal kingdom.*" But here a taxonomic blunder is tumbled into! We can hardly believe that Nelson himself had anything final to say with regard to the title page of this book, but that the editor of the *National Geographic Magazine* got in his work here in the belief so characteristic of editors of popular magazines that their public must be talked *down to*.

But to pin the attention of the reader of this review upon such really minute defects would do violence to the facts in the case, which are that, according to the convictions of the reviewer, Nelson's "Wild Animals of North America" is more uniformly accurate and at the same time replete with information along many lines than any preceding book on American mammals. And even more, it may be declared with confidence that this book is

by far the most important contribution of a non-systematic nature that has appeared in its field in America.

Joseph Grinnell

Museum of Vertebrate Zoology,
University of California

SPECIAL ARTICLES

THE SUBSTITUTION OF SACCHARIN FOR SUGAR

If saccharin can be substituted for sugar it is evident that it must fulfill the functions of sugar and at the same time not produce harmful effects. As a sweetening agent, to be oxidized thereby furnishing energy and to increase oxidation in the body are three functions of sugar. It would seem that saccharin should fulfill admirably the function of sugar as a sweetening agent since it is about 500 times sweeter than sugar. There are some who think that the use of saccharin as a sweetening agent is harmful. The extensive investigations of Herter and Folin[1] for the referee board on the effect of saccharin on the nutrition and health of man show that the amount of saccharin that would ordinarily be used has no deleterious effect. Herter found, in fact, that such enormous doses as 4 grams of saccharin per kilogram of body weight could be given to rabbits without injury. It is recognized that saccharin can not fulfill the second function of sugar named, for it is not oxidized to give rise to energy, but passes through the body almost quantitatively unchanged. The object of the present investigation was to determine if it could fulfill the third function of sugar named, that is, does the ingestion of saccharin increase oxidation in the body. We[2] had already found that the ingestion of sugar, as well as the ingestion of the other food materials, produced an increase in catalase, an enzyme possessing the property of liberating oxygen from hydrogen peroxide, parallel with the increase produced in oxidation, by stimulating the digestive glands, particularly the liver to an increased output of this enzyme. Hence, the conclusion was drawn that the increase in oxidation following the

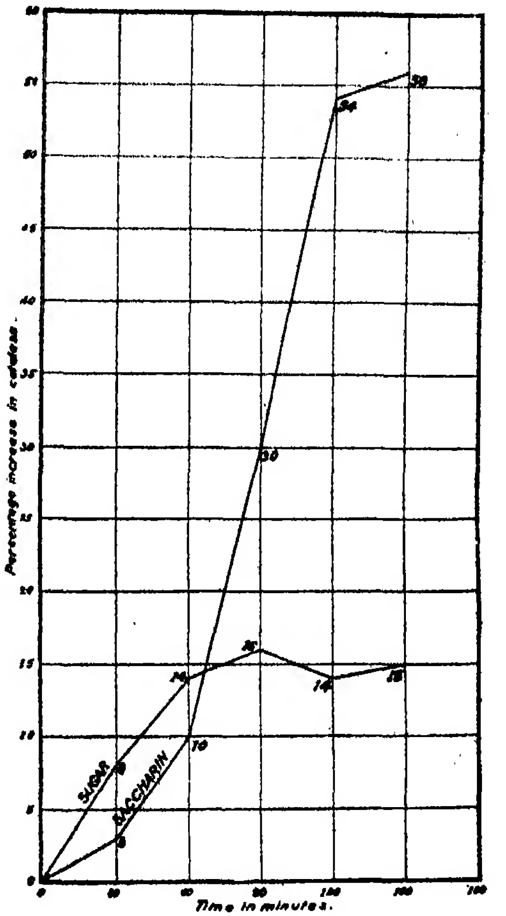


Fig. 1. Curves showing the increase produced in the catalase of the blood by the ingestion of saccharin and of sugar. The figures (0–180) along the abscissa indicate time in minutes; the figures (0–60) along the ordinate, percentage increase in catalase.

ingestion of food was brought about by the increase in catalase. Our contention that catalase is the enzyme in the body principally responsible for oxidation is further supported by the fact, that by whatever means oxidation is increased in the body, there always results a corresponding increase in catalase, and by whatever means oxidation is decreased, there

[1] Herter and Folin, United States Department of Agriculture, Report 94, 1911.

[2] Burge and Neill, *The American Journal of Physiology*, Vol. 47, No. 1.

results a corresponding decrease in catalase. Stated more specifically, the present investigation was begun to determine if the ingestion of saccharin would produce an increase in catalase, and hence an increase in oxidation in the body just as sugar and the other food materials do.

The animals used were dogs. The sugar used was dextrose, and the saccharin "soluble saccharin," prepared by the addition of a solution of sodium carbonate to saccharin. The amounts of these substances used were 4 grams per kilogram of body weight of the animal. They were introduced into the stomach of the animal by means of a stomach tube. Determinations of the catalase of the blood from the jugular vein were made before as well as at thirty minute intervals after the introduction of the materials. The determinations of catalase were made by the addition of 0.5 c.c. of blood to 50 c.c. of hydrogen peroxide in a bottle at approximately 32° C., and the amount of oxygen gas liberated in ten minutes was taken as a measure of the amount of catalase in the 0.5 c.c. of blood.

The curve marked "sugar" in Fig. 1, was constructed from data obtained before, as well as at thirty minute intervals after, the introduction into the stomach of a dog of 4 grams of dextrose per kilogram of body weight of the animal. It may be seen that the sugar produced 8 per cent. increase in catalase during the first 30-minute interval; 14 per cent. increase during the 60-minute interval; and 16, 14 and 15 per cent. increase during the succeeding intervals. Two days later, five grams of "soluble saccharin" per kilogram of body weight were introduced into the stomach of the same dog. The curve marked "saccharin" in Fig. 1, shows the results. It may be seen that the introduction of the "soluble saccharin" increased the catalase of the blood 8 per cent. during the first 30-minute interval; 10 per cent. during the 60-minute interval; 30 per cent. in 90 minutes; 54 per cent. in 120 minutes, and 56 per cent. in 150 minutes. By comparing the effect of the sugar and of the saccharin on the production of catalase, it may be seen that the saccharin produced a much more extensive increase in catalase than did the sugar.

The conclusion is drawn that in addition to being a sweetening agent, saccharin, although not oxidized itself, serves to facilitate the oxidation of the other food materials by stimulating the liver to an increased output of catalase, the enzyme in the body principally responsible for oxidation. Hence, it would seem that saccharin should be positively helpful in the diet, instead of harmful, as some have claimed, particularly in a disease such as diabetes where the principal trouble is defective oxidation.

W. E. Burge

Physiological Laboratory of the University of Illinois

THE AMERICAN ASTRONOMICAL SOCIETY

The twenty-second meeting of the society was held August 20 to 22, 1918, at the Harvard Observatory. Before the gathering it had been expected by many that war conditions would make the attendance so small that it would be scarcely worth while to hold the sessions. As might have been anticipated, however, the number of members of the society residing near Cambridge, together with the staff of the observatory, would make a respectably sized company at any time, and these with the few who were able to attend from a distance made a number which was well up to the average of previous meetings of the society. Although many astronomers about the country are actively engaged in war work, the number of papers presented showed no tendency to decrease, in fact there were the greatest number of communications ever presented at a meeting of the society. This was due primarily to two astronomical occurrences which were not affected by the war, the solar eclipse of June 8, and the appearance of the new star in Aquila. Each of these events was the occasion of about a dozen papers.

In welcoming the society in his double capacity as host and president, Professor Pickering referred to the last previous meetings at Harvard in 1910, when so many foreign astronomers were present, and he expressed the hope that it would not be too long before similar international meetings of men of science could be held again.

In the intervals between sessions the members were afforded the opportunity to inspect the instruments and work of the Harvard Observatory,

which are always a source of admiration to those who belong to less active institutions. There was a special collection of historical photographs arranged for the occasion; and other interesting features selected from the hundreds of thousands of plates now stored and making a permanent record of the sky.

A session was held at the Whitin Observatory, Wellesley College, and also at the Students' Astronomical Laboratory in Cambridge. On the day after the meeting some of the members visited the Massachusetts Institute of Technology, and others made a short cruise on Mr. W. V. Moot's yacht *Adventuress*, which is being used for instruction in navigation.

The society adopted with practically a unanimous vote a committee's recommendation that the astronomical day begin at midnight, and that after January 1, 1925, all astronomical dates should be reckoned in this way. This change will cause much trouble and confusion in astronomical work, but was recommended for the convenience of mariners.

In view of the uncertainty of what conditions would prevail in another year, the council took no definite action in regard to the time and place of the next meeting.

Officers were elected for the ensuing year:

President—Edward C. Pickering.

First Vice-president—Frank Schlesinger.

Second Vice-president—W. W. Campbell.

Secretary—Joel Stebbins.

Treasurer—Annie J. Cannon.

Councilors—E. B. Frost, 1918–20; Otto Klotz, 1918–20; E. W. Brown, 1917–19; S. A. Mitchell, 1918–19.

The program of papers was as follows:

C. G. Abbot: The Smithsonian solar constant observatory at Calama, Chile.

W. S. Adams and A. H. Joy: Spectroscopic observations of *W Ursæ Majoris*.

W. S. Adams and C. E. St. John: The green corona line at the 1918 eclipse.

Robert G. Aitken: The orbit of *Sirius*.

Robert G. Aitken: The spectral classification of 3919 visual binary stars.

Sebastian Albrecht: Personality in the estimation of tenths.

S. I. Bailey: Note on the magnitudes of the variables in *Messier 15*.

E. E. Barnard: *Nova Aquilæ No. 3*.

E. E. Barnard: The prominences of the total solar eclipse of 1918, June 8.

E. E. Barnard: Some remarkable small black spots in the milky way.

Benjamin Boss: Systematic corrections to and weights of stellar parallax.

Benjamin Boss: Real stellar motions.

Benjamin Boss: Stellar luminosities and absolute magnitudes.

Leon Campbell: The light-curve of *Nova Aquilæ No. 3*.

Annie J. Cannon: The spectrum of *Nova Aquilæ No. 3*.

J. B. Cannon: The spectroscopic binary Boss 1275.

Wm. A. Conrad: A short method of mean place reduction with natural numbers.

J. J. Crane: The reduction of Schönfeld's observations to the Harvard photometric standard of magnitudes.

Ralph E. De Lury: Simultaneous variations in solar radiation and spectroscopic determinations of the solar rotation.

Ralph E. De Lury: Spectroscopic measurements of the sun's rotation.

Ralph E. De Lury: The nature of a supposed cyclic variation in the solar rotation.

Ralph E. De Lury: A possible relationship between numbers of meteors and quantities of nitrogen compounds in freshly fallen rain and snow.

A. E. Douglass: The Steward Observatory of the University of Arizona.

A. E. Douglass: Atmospheric haze causing twilight effects.

Alice H. Farnsworth: The color-index of *Nova Aquilæ No. 3*.

Edwin B. Frost: Usefulness of "movie" camera for photographing phenomena of solar eclipses.

Edwin B. Frost and J. A. Parkhurst: The spectrum of *Nova Aquilæ* on June 8, 9 and 10, 1918.

Asaph Hall: A brief description of the 26-inch equatorial instrument of the Naval Observatory, and accessories, etc.

Asaph Hall: Account of some of the series of satellite observations made with the 26-inch equatorial.

W. E. Harper: The orbit of the spectroscopic binary *19 Lyncis*.

W. E. Harper: The orbits of the spectroscopic components of Boss 5173.

W. E. Harper: The spectrum and velocity of *Nova Aquilæ No. 3*.

Margaret Harwood: The variability of *Eros* in 1900–1901.

F. Henroteau: Note on the spectroscopic binary *55 Ursæ Majoris*.

Frank C. Jordan: Notes on the light curves of *XX Cygni* and *U Pegasi*.

Edward S. King: A new method of determining the color of a star.

Jakob Kunz and Joel Stebbins: Photometric results at the eclipse of June 8, 1918.

C. O. Lampland: Variable stars in the *Trifid Nebula* (N. G. C. 6514) and the *Lagoon Nebula* (N. G. C. 6523).

C. O. Lampland: Photographic observations of the variable nebula, N. G. C. 2261.

C. O. Lampland and E. C. Slipher: Some photographic results of the Lowell Observatory solar eclipse expedition.

Henrietta S. Leavitt: The light-curves of eleven novæ.

W. F. Meggers: Solar and terrestrial absorption in the sun's spectrum from 6400 A to 9400 A.

John A. Miller: The total eclipse of June 8, 1918.

R. M. Motherwell: *Nova Aquilæ No. 3.*

R. M. Motherwell: *12 Lacertæ.*

Margaretta Palmer: The Yale index to star catalogues.

J. A. Parkhurst: The spectrum of the solar corona at the eclipse of June 8, 1918.

C. D. Perrine: Changes in the spectra of some early-type stars showing hydrogen emission.

C. D. Perrine: Announcement concerning the formation of a new catalogue of fundamental star positions.

C. D. Perrine: The early spectrum of *Nova Aquilæ No. 3.*

E. Pettit and Hannah B. Steele: Report of the Washburn College eclipse expedition to Matheson, Colorado.

Edward C. Phillips: On a mechanical method of reducing transit observations.

Edward C. Pickering: Relation of proper motions to spectra.

J. S. Plaskett: The 72-inch reflecting telescope.

J. S. Plaskett: Notes on the spectrum of *Nova Aquilæ No. 3.*

Susan Raymond: The variability of *Antigone* (129).

William F. Rigge: The solar eclipse of 1918, June 8, as observed in Omaha.

Luis Rodés: A differential gravimeter and its applications.

Henry Norris Russell: The orbit of *σ Ursæ Majoris.*

R. F. Sanford: The spectrum of Bailey's variable star No. 95 in the globular cluster *M 3.*

R. F. Sanford: The orbit of the spectroscopic binary star *p Velorum.*

Harlow Shapley and J. C. Duncan: The globular cluster *Messier 22* (N. G. C. 6656).

V. M. Slipher: The spectra of two variable nebulæ: a new type of nebular spectrum.

V. M. Slipher: The spectrum of *Nova Aquilæ, No. 3.*

V. M. Slipher: Some spectroscopic results of the Lowell Observatory solar eclipse expedition.

C. E. St. John and Louise Ware: Notes on solar rotation.

H. T. Stetson: War-time instruction at the Harvard Astronomical Laboratory.

H. T. Stetson: Preliminary note on the uniformity of film sensitivity of photographic plates from measures with the thermo-electric photometer.

R. M. Stewart: The position of *Nova Aquilæ No. 3.*

David Todd: On the construction of high-level laboratories for scientific research.

Robert Trümpler: The position and proper-motion of *Nova Aquilæ No. 3.*

Frank W. Very: The luminiferous ether. Its relation to the electron and to a universal atmosphere.

Frank W. Very: What is the bearing of the hypothesis of a gravitational limit on the current relativity discussion?

Frank W. Very: The wasting of stellar substance.

Frank W. Very: Galactic and atomic vortices.

Frank W. Very: On Nipher's "gravitational" experiment and the anomalies of the moon's motion.

R. K. Young: The probable error of radical velocities determined with the one prism spectrograph of the Dominion Astrophysical Observatory.

Meade L. Zimmer: Preliminary note on an annual term in the right ascensions.

Joel Stebbins,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, DECEMBER 6, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

MEANS FOR THE SCIENTIFIC DEVELOPMENT OF MATHEMATICS TEACHERS[1]

THE war just and justly closing has many lessons for teachers. One of these is that those who are best prepared intellectually and have a deep interest in their subject will win in the end. Pedagogy like militarism trains directly for the object, but knowledge of the subject like the development of the general resources of a country gives real power and endurance. I fear our schools, especially our universities, have lately tended towards the former type of training for teachers and it is hoped that one of the lessons of this war is that there is danger in this direction. Pedagogy, as far as it enables the teacher to make students study what they do not want to study, is the militarism of the teaching profession.

Among the other lessons which this war has taught us as teachers of mathematics is not to lose our confidence in the great usefulness of our subject. If any of us were discouraged during recent years by those who talked thoughtlessly but effectively about the uselessness of algebra and geometry we doubtless have largely recovered from this discouragement. The courses for the Students' Army Training Corps, as well as those given under the auspices of the Y. M. C. A. at the various naval stations, exhibit the extensive mathematical needs of those who aim to render the most efficient service under the most trying circumstances. Our new merchant marine will continue to make large demands for men with considerable mathematical training and will thus tend to emphasize the practical usefulness of our subject.

[1] Prepared for the meeting of the Missouri Mathematics Teachers, which was to be held on November 8, 1918, but was postponed on account of the influenza epidemic.

It is still more important to note the value of mathematical training from the point of view of good citizenship. American lower schools devote much more time to mathematics and other sciences than the corresponding schools of Germany and the "German primary and secondary education is more intensely classical and literary than is British."[2] Mathematics has for centuries been most highly appreciated in France and it has been most thoroughly mastered in the French schools. The account which the French soldiers have given of themselves during the world war is therefore the more inspiring to us as teachers of this wonderful subject.

The mathematics teachers are the mothers of mathematical progress, while the investigators are its fathers. Our teachers' organizations are thus a kind of mothers' clubs where we are inclined to discuss chiefly matters relating to the interests of those committed to our care. The highest devotion implies however, more than self sacrifice. It implies also thoughtful and arduous preparation. In fact, such preparation tends to make our tasks much easier and the things that we can do easily are usually done most efficiently. Hard intellectual work should be done only privately. All such public service should be easy as a result of thorough preparation.

My principal object is to inspire some of you to form a new resolution to strive to grow more rapidly along mathematical lines. The scientific development of teachers is not only a state and national question of paramount importance but it is also of international significance. At the outbreak of the world war its instigator Germany offered several prizes for essays relating to the best ways of using the facilities already at hand and of providing additional facilities for advancing the interests of those engaged in teaching.[3]

The glorious intellectual advances made by American secondary teachers during the last two or three decades is reflected in the rapid transformations of our universities in favor of teachers. These transformations have been so rapid and extensive as to give us little time to reflect upon their bearing and may have advanced already beyond the danger point.

The summer sessions and the summer quarters of our universities have grown rapidly in importance and influence. The universities are enlisting more and more their best talent for teachers during the summer terms instead of allowing their less progressive members to utilize them to increase their salaries.

Secondary teachers can not be urged too strongly to attend these summer sessions whenever they can do so without endangering their health. Teachers of mathematics in particular should aim to take at least one or two courses in the department of pure mathematics, and should not devote themselves too closely to the study of the methods or the history of teaching. The main element of interest about mathematics is the subject itself and the more advanced subjects throw the clearest light on the more elementary parts. In fact, these advanced subjects are only the elementary subjects grown to manhood and we understand the boy better after we have watched him develop into a man. Methods, on the contrary, are simply the outer garments of our subject and no amount of dress will make a skeleton attractive.

A child once watched a robin bearing a worm to its nest filled with little ones stretching out their necks and widely opened mouths in eager expectancy. The mother robin gave little heed to these gaping mouths, and, after resting a few seconds on the edge of her nest, swallowed the worm herself. The child was exasperated and called the mother robin a horrid old thing, but the father of the child directed attention to the fact that if the mother robin would not preserve her strength the helpless little robins would soon have no one to provide for them.

This simple illustration may serve to emphasize the need of looking after our own intellectual sustenance and growth. The help

[2] W. J. Pope, "Science and the Nation," 1917, p. 8.

[3] *Zeitschrift für naturwissenschaftlichen Unterricht*, Vol. 45, 1914, p. 521.

we can render our students is a function of many variables but among these variables our own knowledge of the subject which we try to teach is doubtless the most significant. Our enthusiasm for the subject is likely to grow with this knowledge and is another important variable upon which our success will depend. It should also be noted that an enthusiasm which is expressed only in words is not likely to reach the student's heart.

It is somewhat like the enthusiasm of our pro-German fellow citizens who had a change of tongue immediately after our entrance into the world war. While we were glad to see these changes we were inclined to await a change of mind and still more a change of heart. The change of tongue is the easiest human transformation, then comes a change of mind and finally a change of heart. The enthusiasm coming from the heart of the teacher is the only one which is apt to reach the heart of the student, and if your heart is in your subject you will want to know more about it.

While the summer sessions of our universities offer important facilities for the scientific development of our teachers there are other facilities which are less expensive and more permanent. Among these the high-school library deserves especial emphasis. Books are the cheapest educational factors in the world and most young teachers do not buy enough books relating to their own fields of work. What is more important they do not provide enough mathematical reading matter for their students.

The number of popular mathematical books is not very large, but this number is increasing fairly rapidly, and all high-school students should have access to at least a few of them. A few books on the history of mathematics, on mathematical recreation and on general mathematical expositions should be in every high school library. Such mathematical journals as *School Science and Mathematics* and the *American Mathematical Monthly* should also come regularly to every such library. High school students should be frequently encouraged to read mathematical articles in the general encyclopedias.

While the books and journals to which we referred should be accessible to the students of every high school, they should especially be used by the teachers, and they afford important facilities for the scientific development of these teachers. Those interested in larger collections and more explicit references should consult "A list of mathematical books for schools and colleges," containing titles of 160 books suitable for the school or college library, which was prepared by the library committee of the Mathematical Association of America, and published in the *American Mathematical Monthly*, volume 24, 1917, page 368.

It should be emphasized that this list of 160 books is for reference and not for intensive study. One of the greatest dangers which beset those of us who are anxious to become strong mathematicians is scientific dissipation. General mathematical reading is extremely useful but the backbone of the equipment of the mathematician is a profound knowledge of a few subjects, and the mastery of a comparatively small number of books. In fact, I believe that if a man would secure a thorough knowledge of certain nine mathematical books beyond a first course in elementary calculus he would be much better informed than the average candidate for the Ph.D. degree.

The mastery of nine volumes does not appear to be an insurmountable barrier between many young teachers of mathematics and the important goal of holding a place in the ranks of the real mathematicians of our land. I take it that there are many here whose views are in accord with the following words of Bacon, printed for years on the covers of the *Mathematical Gazette:* "I hold every man a debtor to his profession, from the which as men of course do seek to receive countenance and profit, so ought they of duty to endeavor themselves by way of amends to be a help and an ornament thereunto."

The nine mathematical books whose mastery, together with a fair amount of general mathematical reading, and a development of some of the thoughts contained in these books, would make us an ornament unto our profession could be selected with considerable latitude.

As one such selection the following may be noted: Weber, "Lehrbuch der Algebra," three volumes; Goursat, "Cours d' analyse mathématique," three volumes; Veblen and Young, "Projective Geometry," two volumes—the second by Veblen alone; Eisenhart, "Differential Geometry," one volume. Those who do not read German might substitute for the three volumes of Weber's algebra the following: Bôcher, "Introduction to Higher Algebra"; Miller, Blichfeldt and Dickson, "Finite Groups"; Ried, "Theory of Algebraic Numbers." Fortunately the first two volumes of Goursat's "Cours" were translated into English by members of the mathematical department of your state university.

It may be noted that this list of nine volumes contains three volumes on each of the three broad fields of mathematics—algebra, analysis and geometry. Moreover, the mastery of these nine volumes would usually be attended by considerable reference work since some subjects are treated therein too concisely for the average student. Unfortunately there exists at present no good mathematical dictionary in any language. It is to be hoped that the Mathematical Association of America will soon remedy this great drawback, especially for the *private* study of mathematics, and it is interesting to note that the chairman of its committee having this matter under consideration belongs to your own state university.

Those who read French and German can not be too strongly advised to provide themselves with the published parts[4] of the large mathematical encyclopedia, whose completion has been so much delayed by the world war. The French edition of this work is especially complete, as far as it has been published, and our chief objection to the list of 160 library books noted above is that it makes no mention of this superior work of reference. Almost equally reprehensible seems to be the omission of the very useful Volume I., "Subject, Index, Pure Mathematics," Royal Society of London Catalogue of Scientific Papers. Every student should have an opportunity to determine the limits of our present knowledge along particular lines which may interest him.

While the careful study of nine such volumes as were noted above would serve as a kind of admission card to the circle of pure mathematicians it is necessary to emphasize the fact that high standing in this circle would imply various other attainments. One of the foremost of these is a comprehensive knowledge of the literature along at least one important line of mathematical work. Such a knowledge could scarcely be acquired without using French, German and Italian literature. Hence a reading knowledge of these languages, especially the first two, is very important for the prospective mathematician. During the last two or three centuries the French have contributed more than any other nation towards the advancement of mathematics.

We have thus far failed to mention what may appear to many as the foremost qualification for a high position in the circle of mathematicians; viz., research ability of high order. It is true that the highest mathematical honors are usually reserved for those who possess this ability in a high degree in addition to the attainments to which we referred. It is, however, equally true that the highest research is usually spontaneous and takes care of itself provided the proper foundations have been laid and the necessary enthusiasm is present.

It is difficult to see how a man with high mathematical attainments and deep mathematical interest can help doing research work. It is the most charming occupation in the world even when the results appear unworthy of publication. When results are reached which seem to be of permanent value and to serve as rays of light to all future generations the investigator naturally experiences feelings of delight that enrich his inner life as few things do.

The view that all mankind has equal mathematical opportunity in this world is not

[4] This publication is not as far advanced as one would naturally infer from a reference thereto recently made by the retiring chairman of the Chicago Section of the American Mathematical Society on the opening page of an address published in volume 25 of its *Bulletin*.

strictly in accord with facts, but it is becoming more and more nearly true. A little more than three and a half centuries ago Robert Recorde, author of the first book in English dealing with algebra, remarked that "My fortune is not so good to have quite tyme to teache." Notwithstanding his valuable services to education he was compelled to spend the last days of his life in prison on account of his debts.

Some of our modern teachers still feel that their fortune is not so good as to give them quiet time to study, and hence they are using their spare time to add to their financial incomes. It is very unfortunate that the so-called "Tangible Rewards of Teaching"[5] are still so meager, but these rewards have steadily increased, especially during recent years. In a large number of cases they are now sufficient to permit complete devotion to the duties of the position and the necessary study for self-development. According to the report mentioned above, page 318, there was at least one school in this state about six years ago which paid its teachers less than fifty cents a day. It is to be hoped that such conditions do not exist to-day.

The alleviation of the mathematics teachers position is, however, more largely due to the improvement in general library facilities and the maintenance of good mathematical periodicals than to improvements in salaries. It is interesting to note that our leading mathematical journal for teachers of the college grade was started in this state, and was maintained for eighteen years (1894–1912) mainly through the sacrifices of one of your college professors. In 1916 it became the official organ of the Mathematical Association of America.

Such periodicals have done much towards establishing closer contact between mathematicians, and are thus giving to people everywhere a large number of the advantages formerly enjoyed only by those living near the great centers of mathematical activity. They have extended the mathematical advantages of Paris to the whole world. It is still too early to comprehend fully the marvelous mathematical transformation due to the advantages of mathematical journals of various grades. This transformation has been gradual and hence it aroused little comment, but it has largely annihilated distances from mathematical centers, and mathematical research of high order may reasonably be expected to become more and more cosmopolitan.

In recent years a new and important opportunity for service has come to the high school teachers of mathematics. Public libraries have increased in a most encouraging way, but useful mathematical literature is frequently very inadequately represented therein. Teachers of mathematics everywhere should help to correct this situation. They should not only supply those in charge with lists of most suitable mathematical books and journals but they should also encourage their own students to use the mathematical facilities offered by these libraries. If I could encourage the teachers of this state to make a strong effort to have mathematical literature properly represented in their local public libraries I should feel amply repaid for coming to this meeting.

Few students can read such an elementary book as "Philosophy and Fun of Algebra," by Mary E. Boole, without getting new light as regards the real meaning of elementary algebra. The student of elementary geometry will not only take great delight in reading such books as E. A. Abbott's "Flatland," but he will also acquire from it new and important notions as regards the nature of geometric dimensions. Mathematical clubs show that general mathematical questions attract many of our ablest young students and it seems reasonable to suppose that this will always remain true.

It is one of the mathematics teacher's great privileges to help to direct the thought of the younger generation towards a subject of sustaining intellectual interest. One of the interesting experiences of my own student life in Paris was to see two gentlemen beyond the age of sixty follow regularly a course of

[5] A bulletin relating to teachers' salaries was published under this title by the U. S. Bureau of Education as *Bulletin*, 1914, No. 16.

lectures given at the Sorbonne by E. Picard. Mathematics is not only for the young and those who make a living therefrom, but its study leads to an intellectual penetration with unlimited room for growth. Our interest in this subject naturally grows with our knowledge thereof and the former is apt to grow much more rapidly than the latter.

In view of these facts it seems to me that all the larger city libraries should contain a considerable collection of modern mathematical works, including current parts of the best modern mathematical reference work, viz., "Encyclopédie des Sciences Mathématiques," so that new parts of this important work may become available soon after their publication. High school teachers of mathematics can render great assistance in this direction by familiarizing themselves with suitable mathematical collections and the needs of their local libraries, and suggesting improvements to the proper authorities.

Above all let us try to instil in our students a desire for more mathematical knowledge, and encourage them to utilize the facilities of local libraries along mathematical lines. Our large general dictionaries and encyclopedias contain much that can be used to advantage during mathematical recitation periods. It is scarcely necessary to say that such outside contact should not take the place of penetration into the subject in hand, but this penetration is more likely to become attractive if broad contact is kept in mind.

It should be noted that many of our best general works of reference are weak along mathematical lines. As an illustration we may note an entirely senseless definition of regular group appearing under the word *group* in the 1917 edition of the "New Standard Dictionary." This definition is as follows: "a transitive group whose order is the same as that of the letter on which it is made." Such weaknesses are, however, not always harmful to the young student since they may serve to promote the important attitude of mind of not accepting statements without study and verification. As another instance of an unreasonable statement which appeared on the first page of a recent publication of the Department of Commerce, U. S. Coast and Geodetic Survey, No. 92, 1918, we cite the following: "It was his regular custom to spend 17 hours per day in study and writing." An almost equivalent statement appears under the name of J. H. Lambert in the ninth edition of the "Encyclopedia Britannica," but fortunately it is not found in the later edition.

As mathematics teachers, and perhaps as teachers in general, our attitude towards salaries is often inconsistent. In choosing this profession we practically say that we are more interested in intellectual matters than in the making of money. On the other hand, many of our members sacrifice intellectual opportunities for a little increase in salary. Positions which offer a reasonable income together with sufficient time and proper facilities for study should not be abandoned in favor of those offering poorer facilities for intellectual growth but a little more salary. School officials should be impressed by the fact that their teachers appreciate advantages for development and that the best teachers can be secured and held only by furnishing advantages for their development, especially in the form of good library facilities.

The great war for justice and democracy should tend to dignify our high calling since it directs so forcibly attention to the facts that it is sometimes necessary to make great sacrifices for the opportunities for higher development and the rights of nations and of individuals do not depend upon their sizes. We as teachers should be especially impressed by the fact that curtailments of rights must be based on other considerations. With the improvement in world ideals as a result of this war there should come a keener appreciation of thorough preparation for the various duties of life. The appointment of an athlete to a chemical position in Washington for which he was wholly unprepared should be regarded as close to treason even if it may have been due to the ignorance of politicians. Thorough preparation for our various duties should be

our motto as teachers and our own practise should convince the world of our sincerity.

We have thus far considered only the existing means for the scientific improvements of mathematics teachers. It may be desirable to consider also possible new means, for our science is one of infinite progress and hence we naturally look for new things. Possibly the new means for scientific development which I shall outline briefly will appear to you as too idealistic, but high ideals are essential for great progress. Hence I venture to propose that high school teachers should be required to give evidence at the end of every seventh year, until they are forty years old, of having made during the preceding seven years scientific progress equivalent to at least one year of university work.

In fact, this might commonly be in the form of a sabbatical year spent in study at some university. In special cases it might be in the form of attendance at summer sessions, or the publication of scientific work. In all cases is should be understood that the proper authorities would go over the records carefully every seventh year and would insist on such progress as a necessary condition for reappointment. If the young teacher does not grow scientifically at least at the rate of one seventh of the normal growth of the university student he does not possess the type of mind that inspires his pupils properly.

While our young university instructors are not formally subjected to such a rule they are practically subject to a more severe scientific test in our better universities by means of a considerable series of grades, such as instructor, associate, assistant professor, associate professor, professor. In the better institutions each higher grade normally implies scientific attainments which are superior to those required for the next lower grade. It is, of course, difficult to enforce high standards in these times of scarcity of teachers, but with the return of peace we may naturally look for greater competition and higher standards.

To meet these higher standards it is not sufficient that we learn more mathematical facts. Mathematical growth is not based so much on the number of facts as on the kind of facts. The facts must be general and far reaching. A formula involving a parameter is more general than a large logarithmic table because the former contains potentially an infinite number of special values while the latter represents only a finite number of such values. It is, however, necessary to exercise care in regard to the use of the word general in mathematics, for what is often called general is really very special.

If one established theorem includes another it is evidently proper to speak of the former as the more general, but if one undeveloped theory embraces another it is not so clear that the former should always be regarded the more general. It may be that the generality of the principles underlying this theory is too great to permit of much progress. A theory ought to be regarded as general in proportion to its possible development and not in proportion to the generality of the definitions underlying it.

It is evident that such a use of the word general is attended by great difficulties, but it is hard to see how this word can maintain its position of respect in the mathematical literature unless we do make an effort to restrict its use to the potentially larger things. My thought may become clearer if I note the fact that the most general definition of the term group is too broad to serve as the basis of a theory. The most general group theory is therefore of zero extent and will probably always be of this extent. There is a type of definitions which give rise to the most general theory, but it is practically impossible to fix the limitations imposed by such definitions.

As an instance of a tendency to generalize unduly for the pedagogical purposes in elementary mathematics we may refer to one of the oldest among the somewhat complicated mathematical formulas, viz., the *Heron formula* expressing the area of a triangle in terms of its three sides. This formula is found in the majority of our text-books on trigonometry but it is questionable whether it can be regarded as a useful formula for the ordinary

student of trigonometry. It seems easier to solve such a triangle by dividing it into two right triangles and I understand this method is commonly pursued by the engineer. The love for generalization on the part of the teacher seems to have led him in this case to commit a serious pedagogical blunder.

In closing, I desire to urge you to do your own thinking and not to allow yourself to waste energies on the many modern fads appearing under the high sounding term of reform. The very rapid modern transformations have made us unduly vulnerable to the darts of the faddist whose audacity has outstripped that of the mine and oil promoters of the last few decades. A few mines and oil wells have paid handsomely but most of those which have been advertised extensively proved to be disastrous to the too credulous investor. A similar fate has come to those who are too credulous about educational reforms, whether they appear in the form of the function rattle popularized by F. Klein, vocational training, transfer of training, ability tests, or simply the emphasis on methods above knowledge.

As a result of the many wildcat propositions the universities used to avoid pedagogical investments altogether and they used to be fearless in warning the public against investing their hard-earned money in this way. During recent years, however, our American universities have abandoned this policy, under the leadership of Columbia, and have invested heavily in this line of securities. At first they selected the best class only but recently they seem also to invest heavily, again under the leadership of our largest university, in the more doubtful class. This is done even in the graduate schools.

Hence the public has become more and more unwary, and wildcat pedagogical promotions are thriving as never before. The richness of a few reputable pedagogical mines has served to inspire hope as regards others whose only asset is proximity to the former. Hence the grave need of caution at the present time. The educational public would seem to need some public educational commissions similar to those recently inaugurated along financial lines to protect the ever too gullible public. The scientific development securities to which I directed your attention above do not promise the largest returns but they have withstood the severest test of the ages and hence they should be regarded as the soundest of all intellectual investments. Our students need to be trained to enjoy ideals as well as to utilize the real. Mathematics is the ideal science and there is more moving than improving in reforms.

G. A. Miller

University of Illinois

BANDED STRUCTURES OF THE ADIRONDACK SYENITE-GRANITE SERIES

The syenite-granite series constitutes the greatest bulk of Adirondack rock. It is younger than both the Grenville metamorphosed sedimentary series and the anorthosite, the former especially having been broken up and badly cut to pieces by the syenite-granite intrusion. In mineral composition the range is from syenite rich in microperthite, orthoclase, and hornblende or augite, together with some plagioclase; to granite rich in microperthite, quartz, orthoclase and microcline, together with some plagioclase, hornblende and biotite; to monzonitic and dioritic facies rich in plagioclase, orthoclase, pyroxene and hornblende. Medium grained rocks greatly predominate but there are many variations to fine and coarse grained and even porphyritic facies. Granulation is common, the feldspars especially being most notably crushed. In structure the syenite-granite series exhibits all sorts of variations from non-gneissoid to excessively gneissoid types, with a moderate degree of foliation prevalent. The color of the typical fresh syenite is greenish-gray, while the fresh granite varies from greenish-gray, to light gray, to light red.

In this paper the features of special interest in connection with the syenite-granite series are the comparatively sharp transitions from acidic to basic facies; from greenish-gray or gray to pink or red varieties; from coarser to

finer grained types; from highly gneissoid to very slightly or moderately gneissoid facies; and from notably granulated to only moderately granulated varieties. The effect is to give bands or layers of varying composition, color, granularity, foliation and granulation, yet all clearly belonging to a single rock body. Such bands or layers usually vary in width from an inch to a hundred feet or more, and in length from a few feet or rods to a quarter of a mile. Banded structures of this sort are common throughout the Adirondack region, but it should be made clear that they are by no means universal. Large bodies of syenite or granite are often remarkably uniform and free from any notable variations or banding.

Bands of amphibolite which, in many places, cause the syenite or granite (more especially the latter) to exhibit a very pronounced banded structure are not considered in this paper. These present some puzzling features and data regarding their significance are now being gathered by the writer. Also, distinct inclusions of various types of undoubted Grenville gneisses which, in the form of lenses or layers, in many places produce a banded structure are not discussed except in so far as they throw light upon some banding of the syenite-granite which has resulted from magmatic assimilation of such inclusions.

Of the many hundreds of observed examples of banded structures considered to be essentially the result of magmatic differentiation, a few will be described in order to give a proper conception of the more common and characteristic variations.

On the mountain spurs, respectively one mile northeast and two miles east of Whitehouse (Lake Pleasant quadrangle), there are shown many facies of the syenite-granite series ranging from greenish-gray hornblende syenite and granite syenite to gray and pink granite and coarse, almost prophyritic, granite. Such rocks play back and forth upon each other by sharp transitions repeatedly for a distance of one half of a mile on each mountain spur where the almost barren ledges are conspicuously banded in layers usually from a few feet to a few rods wide and parallel to the foliation. These bands show many diffenences in foliation, granulation and granularity. Variations of this sort are perhaps the most abundant throughout the Adirondacks.

By the road one and one half miles southwest of Long Lake village (Blue Mountain quadrangle) a freshly blasted ledge finely exhibits bands of greenish-gray syenite, granitic syenite, and gray granite. One band of light gray hornblende granite two and one half feet wide passes by insensible gradations into greenish-gray pyroxene syenite on either side. The bands are parallel to the foliation which varies considerably.

A hand specimen taken from a ledge by the lake shore near Adirondack village (Schroon Lake quadrangle) is distinctly foliated and granulated with a pink band especially rich in feldspar adjacent to a band very rich in quartz plus some garnets, these two bands having on either side gray granite consisting of quartz, feldspar, hornblende and some biotite. These very narrow bands, not sharply separated from each other, are parallel to the foliation. In the same quadrangle, one half of a mile north of Moxham pond, granite in a road metal quarry shows notable variations in coarseness of grain often within a foot or two.

The red hornblende granite of the northern portion of the Port Leyden quadrangle often contains bands of gray quartz syenite in subordinate amount parallel to the foliation. Good exposures are by the lower road crossing on Otter creek.

Professor Cushing, describing the granitic syenite of the Long Lake quadrangle, says:

> Much of the rock is alternately green and red, quite quartzose, and a rock distinctly intermediate between syenite and granite, often passing into granite. Much of it is uniformly red, and the rocks range from syenite to granite in composition.[1]

Professor Kemp, in his description of the syenite of the Elizabethtown-Port Henry quadrangles, says:

> The most acidic variety will quite sharply replace it (syenite); and in the same way a very basic variety may come in and constitute the section for 50 or 100 feet or more. Yet while the

[1] N. Y. State Mus. Bul. 115, p. 478.

transition is sharp there is no evidence of separate intrusive masses.[2]

The interbanding of syenite and granite above cited as occurring in the Long Lake and Elizabethtown quadrangles are by Cushing and Kemp, respectively, interpreted as being most likely due to some process of magmatic differentiation. Kemp says that one is not "justified in inferring more than a differentiation of an eruptive mass into layers or portions of contrasted composition." For most cases throughout the Adirondacks, especially the very common occurrence of banded variations like those illustrated in the above examples, the writer agrees with this interpretation since there appears to be no escape from the idea of some sort of differentiation of the magma into layers of varying composition. Transitions between layers range from sharp to very gradual, but in a typical case the whole body of rock is, as Cushing says, "manifestly bound together as a mass of eruptive material arising from a common magma." Whether or not the transitions are sharp, they are always marked by interlocking crystals.

But what were the physical conditions under which the differentiation occurred? Did the differentiation take place before, or after, or during the process of intrusion? The writer ventures to offer some suggestions by way of partial answers to these questions.

M. E. Wilson has discussed the banded gneisses of the Laurentian Highlands of Canada[3] which are essentially very similar to those of the Adirondacks. In his summary Wilson says: "As regards the origin of the folded, banded and foliated structure of the gneisses, it is concluded that these are all genetically related in the Laurentian mountain-building deformation which acted upon the magmatic axil mass during its consolidation" and "that the principal factor in bringing about the heterogeneity of the Laurentian complex was differentiation aided by (orogenic) deformation during its consolidation."

Now, in the main portion of the Adirondack region the banded syenite-granite series shows little, if any, folding due to orogenic pressure, and the foliation is essentially a magmatic flow-structure produced under moderate pressure, that is a pressure little or no greater than that which resulted from the shouldering action of the syenite-granite magma during its intrusion. Reasons for these conclusions are given at some length by the writer in a recent paper.[4] Such being the case, *orogenic* pressure was not a principal factor in the profeature of the whole central belt of Laurentian duction of the banded structures of the Adirondack syenite-granite series. Wilson states that the banding is a very persistent Highland gneisses, but in the Adirondacks the more localized developments of pronounced banded structures strongly oppose the idea that they were produced under general regional or orogenic pressure. The writer believes, therefore, that orogenic pressure has not been a necessary condition for the production of banded gneisses such as those described in this paper.

It may well be conceived, however, that, in those portions of the rising magma where the shouldering pressure was greater, the differentiation into layers of contrasting composition, color, texture and foliation proceeded more readily, while in other (often large) portions of the magma, where the shouldering pressure was relatively slight, the conditions for differentiation into contrasting bands were not so favorable. The influence of pressure in the production of the banding is thus recognized.

It is further believed that the syenite-granite magma rose very slowly and irregularly, and that there was differential magmatic flowage, especially in those portions where the contrasting bands were developing. Many of the bands are not considered to have consolidated simultaneously since alternating bands showing sharp differences in degree of magmatic flow-structure foliation prove that some of the layers were more fluid and continued to flow after adjacent layers were wholly or nearly consolidated. Accordingly, where the banded structures are well developed we may picture not only the slow intrusion of the

[2] N. Y. State Mus. Bull. 138, p. 48.

[3] *Am. Jour. Sci.*, Vol. 36, pp. 109–122.

[4] *Jour. Geol.*, Vol. 24, pp. 587–619.

heterogeneous syenite-granite magma split up into layers, but also differential movements of the layers, at least during late stages of magma solidification. This conception does not, however, preclude the possibility of some differentiation after portions of the magma came to rest, or even before the intrusion began. In fact it is reasonable to suppose that the commonly occurring large-scale, irregular, gradual transitions from granite and granite porphyry to syenite and even diorite may have resulted from differentiation of the syenite-granite magma before, or during an early stage of, the intrusive process.

Another explanation, supported by field evidence, to account for at least some cases of banded structure should be mentioned. Thus at a number of localities gray or greenish-gray basic syenite or even diorite bands occur in the syenite-granite series where dark Grenville gneiss or amphibolite inclusions are also common. Both igneous-looking bands and inclusions lie parallel to the foliation of the country rock. Sometimes the boundaries of the inclusions are very sharp, but in other cases they are not, and plainly more or less fusion of the inclusions has taken place. All stages from thoroughly fused and absorbed inclusions to others where little or no fusion has taken place may be seen. The thoroughly fused inclusions have a distinctly igneous appearance and their boundaries of course merge into the enclosing rock yielding a more or less well developed banded structure. Some typical cases of this kind of magmatic assimilation are described by the writer in a recent paper,[5] and still others in various New York State Museum bulletins by the writer. Of the large number of cases which have come under the writer's observation, nearly all are of very minor extent, and usually such banding is definitely recognizable as having resulted from assimilation rather than pure differentiation. There is no positive evidence that large bodies of the syenite or granite have been appreciably changed in composition due to the incorporation or assimilation of Grenville rocks. Thus, while it seems certain that assimilation has played a minor rôle in the production of banding of the syenite-granite series, the actual quantitative importance of assimilation as compared with differentiation is by no means definitely known.

William J. Miller

Smith College

[5] *Geol. Soc. Amer. Bull.*, Vol. 25, pp. 254–260.

PROCEEDINGS AND RESOLUTIONS OF THE THIRD RESUSCITATION COMMISSION[1]

The Commission met in New York at the Rockefeller Institute on Friday, May 17, 1918. There were present at the meeting: Passed Assistant Surgeon E. F. DuBois, U. S. N. R. F., of the Bureau of Medicine and Surgery, Navy Department; Dr. D. L. Edsall, professor of medicine and dean, Harvard Medical School; Mr. W. C. L. Eglin, chairman of committee on safety rules and accident prevention of the N. E. L. A.; Dr. Yandell Henderson, professor of physiology, Yale University and consulting physiologist of the Bureau of Mines; Dr. Wm. H. Howell, professor of physiology and assistant director of the school of hygiene and public health, Johns Hopkins University, member of the National Academy of Sciences; Dr. Reid Hunt, professor of pharmacology, Harvard Medical School, Secretary of Commission; Professor A. E. Kennelly, professor of electrical engineering at Harvard University and the Massachusetts Institute of Technology; Dr. Charles A. Lauffer, medical director of the Westinghouse Electric Co., Pittsburgh, Pa.; Dr. S. J. Meltzer, Rockefeller Institute, chairman of the commission, member of the National Academy of Sciences; Dr. Joseph Schereschewsky, Assistant Surgeon General, U. S. Public Health Service; Dr. G. N. Stewart, professor of experimental medicine, Western Reserve University, Cleveland; Professor Elihu Thomson, General Electric Co., West Lynn, Mass., member of the National Academy of Sciences; Lieutenant Colonel Edward B. Vedder, of the Army Medical

[1] Held under the auspices of the Committee on Safety Rules and Accident Prevention of the National Electric Light Association. Edited by Professors Howell, Stewart and Thomson.

School; Major Frank G. Young, of the Ordnance Division of the War Department.

A telegram was received from Surgeon-General Gorgas that Dr. Charles H. Frazier, professor of surgery, University of Pennsylvania, is to represent his office. (In a subsequent communication Major Frazier accepted his appointment.) Conferees: Mr. P. H. Bartlett, Philadelphia Electric Company; Mr. Wills Maclachlan, Electrical Employers Association, Toronto, Canada; Mr. C. B. Scott, chairman of the sub-committee on accident prevention N. E. L. A.; Dr. F. E. Schubmehl, General Electric Co., West Lynn, Mass.

The object of the commission, the chairman stated, is to consider efficient methods of artificial respiration in emergency cases, *as they are met with in peace as well as in war.* For more than a century, England has had several life-saving societies, and many special commissions have been appointed to investigate the methods employed in resuscitation. In this country, about six years ago, a commission on resuscitation from electric shock was created for the first time, by the initiative of the National Electric Light Association. It is now generally recognized that efficient artificial respiration is, for such conditions, the best and practically the only means available for resuscitation. It requires but little consideration to realize that the need for an efficient means of artificial respiration is very wide-spread.[2] The committee on safety rules and accident prevention of the N. E. L. A., of which Mr. Eglin is the chairman, agreed that *the Third Resuscitation Commission should consider its problems from a general point of view.*

Mechanical Methods.—Dr. Meltzer demonstrated in the laboratory for physiology and pharmacology, the efficiency of the method of pharyngeal insufflation in an etherized dog *after complete removal of the anterior wall* of the thorax, in which the lungs and heart were exposed to full view.

Dr. Rossiter, of the Carnegie Steel Company, demonstrated the latest device of the Pulmotor Company, which is not identical with the original pulmotor. He showed also the original pulmotor. He stated that he had resuscitated eight gas cases, in which the respiration had stopped. This was done by the original pulmotor, in which he had more confidence.

Dr. James M. Booher, medical director of the Life Saving Devices Co., demonstrated the lungmotor. He showed a number of blood-pressure tracings, taken from animals which had received artificial respiration by means of this apparatus. In reply to a question, Dr. Booher stated that in these experiments the lungmotor was connected with the animal by means of a tracheal cannula. (In human cases the lungmotor is applied by means of a face mask.) Dr. Booher left with the commission histories of a number of cases in which the lungmotor had been used. (The commision found no time to examine these written histories, but Dr. Booher mentioned verbally especially two cases. One of these cases was subsequently investigated by the chairman. The life of a poliomyelitis patient with complete paralysis of the respiration was maintained for thirty-six hours by means of the lungmotor. The reporting physician is of very good standing.)

In introducing Mr. Foregger, the chairman explained that the physician who was most competent to present the details of the apparatus of the Foregger Company is now in France. The apparatus consists in modifications of the insufflation apparatus of Meltzer. Among other changes, the apparatus carried an oxygen generator tank. In reply to a question, Mr. Foregger stated that the oxygen thus generated may last eight or ten minutes.

[2] For instance, in injuries to the head which stop respiration, injuries to the chest (especially double pneumothorax) in laparotomies during which the respiration ceases occasionally, in cases of shock which occur in peace and more so in the present war, in poliomyelitis with stoppage of respiration, in post-diphtheretic paralysis, in poisoning by opiates, by volatile gases (ether, chloroform, etc.) by mine and fuel gases, poisoning by magnesium salts, in electric shock and in drowning.

Manual Methods.—Mr. Eglin read a letter from Mr. M. W. Alexander, of the General Electrical Co., stating that he hoped the "commission would be very definite in recommending the prone-pressure method, as experience has proved its value."

Mr. C. B. Scott stated that the accident prevention committee of the N. E. L. A. had reached the point in its investigation where it felt that the prone-pressure method was best to recommend, bearing in mind that machines are not always available in emergencies. His own company had had nine successful cases of resuscitation by the prone method and three unsuccessful cases in which mechanical means were used.

Dr. Schubmehl stated that the prone-pressure method has been most successfully applied by their two hundred and twenty-five first-aid men.

Mr. Maclachlan stated that he had the duty of training possibly three thousand men in the prone method. Their system required the men to practise this method at least once a month. The men are instructed not to desist in less than three and a half hours, and that not till then should they listen to advice from a physician who might tell the operator that the patient was dead.

The secretary read the following parts of a letter from Professor Schäfer, of Edinburgh, to the chairman: "The prone method has been adopted *exclusively* for about twelve years by the Royal Life Saving Society, the only important organization in the British Empire whose object is the resuscitation of the apparently drowned. It has also been adopted for several years by the London and other Police Force, by the Board of Trade, by the Army and the Navy." "The most important thing is in cases of drowning to have something ready which any man can use; which will effect respiratory exchange—whether exactly as much as normal, matters very little."

RESOLUTIONS ADOPTED BY THE COMMISSION

In the discussion following the presentation of methods and evidence to the commission the following important facts were emphasized:

1. That in most accident cases no resuscitation apparatus is at hand for immediate use.

2. That reliance upon the use of special apparatus diminishes greatly the tendency to train persons in the manual methods and discourages the prompt and persevering use of such methods.

3. That police officers or physicians often interfere with the proper execution of manual methods, in that they direct that the patient be removed in an ambulance to some hospital, thus interrupting the continuance of artificial respiration.

4. That in many hospitals the members of the staff are not all acquainted with the methods of artificial respiration.

5. That in medical schools instruction is not properly provided for students in the manual methods of artificial respiration.

In view of these facts the following resolutions were adopted by the commission:

1. The prone-pressure or Schäfer method of resuscitation is preferable to any of the other manual methods.

2. Medical schools, hospitals, fire and police departments, the Army and Navy, first aid associations, and industrial establishments in general, should be urged to give instruction in the use of the prone-pressure method of resuscitation.

3. Individuals who, from accident or any other cause, are in need of artificial respiration, should be given manual treatment by the prone-pressure method immediately on the spot where they are found. It is all important that this aid be rendered at once. The delay incident to removal to a hospital or elsewhere may be fatal, and is justifiable only where there is no one at hand competent to give artificial respiration. If complications exist or arise, which require hospital treatment, artificial respiration should be maintained in transit, and after arrival at the hospital, until spontaneous respirations begin.

4. Persons receiving artificial respiration should, as much as possible, be kept warm and the artificial respiration should be maintained till spontaneous breathing has been permanently restored, or as long as signs of life are present. Even in cases where there is no sign of returning animation, artificial respiration should be kept up for an hour or more.

5. A brief return of spontaneous respiration is not a certain indication for terminating the treatment. Not infrequently the patient after a temporary recovery of respiration stops breathing again. The patient must be watched and if normal breath-

ing stops, the artificial respiration should be resumed at once.

6. Artificial respiration is required only when natural respiration has ceased. In cases of simple unconsciousness from any cause in which natural respiration continues, artificial respiration should not be employed without medical advice.

7. The commission recommends that in cases of gas asphyxiation, artificial respiration, whether given by a manual method or by special apparatus, should be combined when possible with the inhalation of oxygen from properly constructed apparatus.

8. With regard to the employment of mechanical devices for artificial respiration the commission feels that it ought not at present to take a definite stand either for or against any particular form of apparatus. However, the commission recommends, that the use and installation of apparatus should be confined, for the present, to properly equipped institutions under medical direction. The commission recognizes the great need of simple devices capable of performing artificial respiration reliably and efficiently. It therefore recommends careful study of the problem, directed toward *the development of a reliable method appropriate for general adoption.*[3] Such studies can best be carried on in properly equipped hospitals and laboratories which offer opportunities and facilities for critical observation and experimentation.

In view of the importance which the knowledge of proper methods of resuscitation possesses for public health and safety, and considering the fact that many practitioners, members of hospital staffs and graduates of medicine are not thoroughly familiar with the methods of resuscitation, especially that of the prone-pressure method, the commission recommends:

(*a*) That medical journals (and other scientific and practical journals which are interested in the problem of resuscitation) be asked to publish the resolutions adopted by the commission.

(*b*) That a copy of these resolutions be sent to the medical colleges with a request that proper instruction in this subject shall be arranged for in the *College Schedules*.

(*c*) That these resolutions be sent to as many hospitals as possible, with the recommendations that members of the house staff shall familiarize themselves with the methods of resuscitation.

[3] See Appendix.

(*d*) In order that the resolutions of the commission may be brought to the attention of interested circles (fire and police departments, industrial plants, etc.) it was agreed that they be communicated to the Associated Press (by the National Electric Light Association).

It was voted that the Third Resuscitation Commission should be properly organized and continue its existence, ready to respond when requirements arise. The following officers were elected:

President—Dr. S. J. Meltzer.
Vice-president—Dr. Yandell Henderson.
Secretary—Dr. Reid Hunt.
Treasurer—Mr. W. C. L. Eglin.

It was voted to appoint a committee for the collection of verifiable data relating to resuscitation. The president appointed to the committee—

Dr. D. Edsall—Chairman,
Dr. Reid Hunt—Secretary,
Professor Elihu Thomson, and the President Ex-officio.

APPENDIX

The commission consists of fifteen members. Fourteen approved the foregoing report without qualifications. The fifteenth member wishes to qualify his vote by the following

Statement

Dr. Yandell Henderson qualifies his support of the resolutions as follows:

While I concur in a considerable part of the report of the Resuscitation Commission I dissent from the statement in Resolution 8 recognizing "the great need of simple devices capable of performing artificial respiration reliably and efficiently."

Devices which are excellent from the mechanical standpoint are now available and widely sold; but the evidence regarding them indicates clearly, I believe, that even if these devices were on the spot where several gassings or electrocutions occurred, and if all the victims were treated with them, except one who was given manual (prone pressure) treatment, this one would have much the best chance of recovery. In actual practise the apparatus is seldom right on the spot adjusted and ready. Critical time is lost, and thus in the above suppositious cases, as they actually occur, the only victim with any considerable chance of resuscita-

tion (aside from those who recover spontaneously and are credited to the apparatus) is the one treated manually.

Even more important is the fact, demonstrated now by universal experience, that when apparatus is known to be obtainable, it is sent for and the manual method neglected. Thus to-day the apparatus in public use is on the whole contributing very materially to decrease the saving of life.

SCIENTIFIC EVENTS

PROTECTION GIVEN MIGRATORY BIRDS BY AMENDMENTS TO THE BIRD-TREATY ACT

The United States Department of Agriculture announces the promulgation of amendments and additions to the Migratory Bird-Treaty Act Regulations effective October 25, 1918.

Hereafter the open season for black-bellied and golden plovers and greater and lesser yellowlegs in Texas will be from September 1 to December 15. Another change prescribes a daily bag limit of 50 sora to a person in addition to the bag limit of not to exceed 25 for other rails, coots and gallinules.

An amendment of Regulation No. 6 has the effect of removing the limitation on the number of birds that may be transported within a state during the federal open season. The export of migratory game birds is limited to two days' bag limit during any one calendar week of the federal season. Persons must comply with state laws further restricting the shipment or transportation of migratory birds.

An amendment to paragraph 2 of Regulation No. 8, which is of great interest to breeders of game, permits migratory water fowl raised in domestication to be killed by shooting during the respective open seasons for waterfowl, and the sale thereof to state laws; but after March 31, 1919, such waterfowl, killed by shooting, can not be sold or purchased unless each bird, before attaining the age of 4 weeks, shall have had removed from the web of one foot a portion thereof in the form of a "V" large enough to make a permanent well-defined mark, which shall be sufficient to identify it as a bird raised in domestication.

Another amendment provides that the plumage and skins of migratory game birds legally killed may be possessed and transported without a federal permit. Provision is also made for the issuance of special permits authorizing taxidermists to possess, buy, sell and transport migratory birds.

Two new regulations have been added. Regulation No. 11 provides for the issuance of permits authorizing persons to sell migratory game birds lawfully killed and by them lawfully held in cold storage on July 31, 1918. Such birds may be sold under permit until March 31, 1919.

Another new regulation is as follows:

> Nothing in these regulations shall be construed to permit the taking, possession, sale, purchase or transportation of migratory birds, their nests and eggs contrary to the laws and regulations of any state, territory or district made for the purpose of giving further protection to migratory birds, their nests and eggs when such laws and regulations are not inconsistent with the convention between the United States and Great Britain for the protection of migratory birds concluded August 16, 1916, or the migratory bird treaty act, and do not extend the open seasons for such birds beyond the dates prescribed by these regulations.

This regulation is a restatement of the substance of section 7 of the migratory bird-treaty act, and is intended to remove the confusion and uncertainty that exists in regard to the effect of the federal law and regulations on state game laws.

The federal migratory bird-treaty act regulations prohibit throughout the United States the killing at any time of the following birds: Band-tailed pigeon; common ground doves and scaled doves; little brown, sandhill and whooping cranes; wood duck, swans; curlews, willet, upland plover, and all shore birds (except the black-bellied and golden plovers, Wilson snipe or jacksnipe, woodcock and the greater and lesser yellowlegs); bobolinks, catbirds, chicadees, cuckoos, flickers, flycatchers, grossbeaks, humming birds, kinglets, martins, meadow larks, nighthawks or bull-bats, nuthatches, orioles, robins, shrikes, swallows, swifts, tanagers, titmice, thrushes, vireos, warblers, waxwings, whip-poor-wills, woodpeckers and wrens, and all other perching birds which feed entirely or chiefly on insects; and also auks, auklets, bitterns, fulmars, gannets, grebes, guillemots,

gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters and terns.

POTTERY PRODUCTS

THE makers of pottery in the United States reported another record-breaking year in 1917 in value of output, which was $56,162,522, an increase of $7,945,280, or more than 16 per cent. over the value in 1916, according to figures compiled under the direction of Jefferson Middleton, of the United States Geological Survey, Department of the Interior.

The imports of pottery during the year were necessarily small, and the demand was fully equal to the largest domestic supply that would have been produced under normal coduditions, but the American potters found it impossible to supply the demand. Though the value of the output was the largest yet recorded, the volume of the product was probably not so large as it had been in some other years. Few plants, if any, ran to capacity, and many of them did not market more than three fourths of their normal output. The increased cost of labor and raw materials made it necessary to fix higher prices for the wares than those that have prevailed in the last few years. The imports showed an increase over those of 1916 but were much below normal imports before the war. This increase was due chiefly to greater imports from Japan, whose wares are now finding a larger market in the United States.

Notwithstanding the handicaps which the pottery industry suffered in 1917, greater efforts were made to place the industry on a firmer foundation than ever. Realizing that after the war he will have the keenest competition, and knowing that in order to hold his present trade he must not only make ware of superior quality but must be able to undersell all foreign competitors, the American potter has begun to study not only how to improve the quality of his wares but to find or devise labor-saving machines and improved kilns. The report of the United States Potters' Association shows that a number of such devices that give promise of lowering the cost of labor and fuel were introduced in 1917 or were being successfully developed. Among these devices are sagger-making machines, a conveyer type of stove, a casting process that makes large production possible by unskilled labor, and down-draft and tunnel kilns that insure a large saving of fuel.

The effort to establish in the southern states a pottery for the manufacture of high-grade ware has, after many years, at last been successful. In 1917, for the first time, white ware was manufactured in the south. The Southern Potteries (Inc.), began to operate at Erwin, Tenn., a 10-kiln plant for the manufacture of semi-vitreous porcelain table ware, using domestic clays exclusively.

Another important development in the pottery industry of the United States is the production of chemical porcelain, the manufacture of which in this country was considered impossible before the war. Several operators are now making chemical porcelain which satisfactorily meets the exacting requirements of the laboratory.

In 1917 the value of the output of every variety of pottery classified by the Geological Survey, except red earthenware, was greater than in 1916. White ware showed the largest increase—$2,729,079, or 15 per cent. Porcelain electrical supplies also showed a large increase —$2,417,166, or 34 per cent. China, the highest grade of pottery, has been a minor product in value, yet its value in 1917 showed an increase of $1,327,534, or 38 per cent., compared with 1916. Its value in 1917 was nearly twice as great as in 1913.

The value of white ware, including china, which comprises the general household wares and constitutes more than 45 per cent. of the value of all pottery, was $25,726,375 in 1917, an increase of $4,056,613, or 19 per cent., over 1916. If to this sum is added the value of the high-grade products sanitary ware and porcelain electrical supplies, the total value in 1917 was $47,814,178, or $7,998,579 more than in 1916.

THE NATIONAL ACADEMY OF SCIENCES

THE scientific program at the recent Baltimore meeting was as follows:

Cloud reflection and the albedo of the earth and Venus. C. G. Abbot.

Colorimetry of white surfaces. A. H. Pfund, introduced by J. S. Ames.

The inorganic constituents of lobster shells. F. W. Clarke and G. Steiger.

Hydrocephalus. Experimental and clinical study. W. E. Dandy, introduced by W. S. Halsted.

Clinical and experimental observations in cases of arterio-venous and lymphatico-venous fistulæ. W. S. Halsted

Quantitative relations between chromatin and cytoplasm in the genus *Arcella*, with their relations to external characters. R. W. Hegner, introduced by H. S. Jennings.

The physiological effects of air-concussion. D. R. Hooker.

Two new factors in blood-coagulation. W. H. Howell.

Is the arrangement of the genes in the chromosome linear? W. E. Castle.

Cause of phyllomania in *Begonia*. E. F. Smith.

Comparative morbidity of white and colored troops. Chas. B. Davenport and Albert G. Love.

Second report on researches on the chemical and mineralogical composition of meteorites (illustrated). George P. Merrill.

Theory of wind instruments; The ballistic resistance function; The dynamics of the rifle fired from the shoulder. A. G. Webster.

Biographical sketch of George Davidson. W. W. Campbell. (By title.)

SCIENTIFIC NOTES AND NEWS

IN addition to the national scientific societies announced in SCIENCE last week as meeting in affiliation with the American Association for the Advancement of Science at Baltimore during convocation week, the Society of American Bacteriologists will meet on Friday and Saturday, December 27 and 28. The president is Dr. R. C. Buchanan, and the secretary, Dr. A. Parker Hitchens, Army Medical School, 462 Louisiana Ave., Washington, D. C.

IN view of the changed conditions after the armistice, the council of the American Psychological Association has decided to reconsider the postponement of the annual meeting. It has now been definitely planned to have a brief and rather informal meeting upon war topics on December 27 and 28, at Baltimore. A detailed announcement will be sent to members shortly.

THE Inter-Allied Scientific Conference after its meeting in London under the auspices of the Royal Society adjourned to Paris where it continued at the end of November its meetings under the auspices of the Academy of Sciences. The American delegates are: Dr. H. A. Bumstead, Colonel J. J. Carty, Professor W. F. Durand, Dr. Simon Flexner, Dr. George E. Hale, and Professor A. A. Noyes.

AT a recent meeting of the New York branch of the American Chemical Society held at the Chemists' Club, resolutions were passed proposing the organization of an American Chemical Institute under the auspices of the American Chemical Society, whose special function shall be to promote research with a view to the introduction of new or improved medicinal products, so as to make the United States free of any future effort to control this field by German manufacturers.

SENATOR ROBERT S. BROOKINGS, of Missouri, has been named by the Senate to be a regent of the Smithsonian Institution to succeed the late Charles W. Fairbanks.

WITH the rank of Lieutenant Colonel, Dr. William Pepper, Dean of the University of Pennsylvania Medical School, has been reassigned to work at Fort Oglethorpe, Georgia.

DR. GEORGE A. BAITSELL, assistant professor of biology in Yale University, has been granted leave of absence to accept an appointment as captain in the Chemical Warfare Service, United States Army.

DR. M. F. BARRUS, of the department of plant pathology at Cornell University, has recently been commissioned first lieutenant in the Quartermaster's Corps. He will be engaged in the crop production work of the army.

DR. A. G. MCCALL, in charge of the soil investigational work of the Maryland Experiment Station, has been selected by the army

overseas educational commission to take charge of the soils and fertilizer work in France during the demobilization period. Dr. McCall will arrange to continue his work for the National Research Council on the salt nutrient requirements for plants.

Dr. George T. Moore, director of the Missouri Botanical Garden, has been appointed director of the productions division of the United States Food Administration for St. Louis.

Professor Dan Otis, assistant dean of agriculture in the University of Wisconsin, has received an appointment from the government as farm management specialist for France.

Dr. Reginald A. Daly, Sturgis-Hooper professor of geology at Harvard, is a member of the committee which will have charge of the courses of instruction to be maintained in Europe for United States soldiers until they return to this country.

Major R. W. Brock, of the University of British Columbia, has been appointed geological adviser to the British Army in Palestine. For the last two years he has been overseas on military duty.

Mr. Wm. B. Brierley, of the pathological laboratory, Royal Botanical Garden, Kew, and formerly lecturer in economic botany to Manchester University, has accepted the appointment of mycologist to the new Institute of Phytopathological Research, Rothamsted Experimental Station, Harpenden.

At Cambridge the Gedge prize for original observations in physiology has been awarded to Mr. Thomas Richard Parsons, B.A., of Sidney Sussex College, formerly of Birkbeck College, for an essay on "The reaction of blood in the body."

During his stay in England as the representative of the United States Public Health Service, Professor Frederic S. Lee has been asked to sit on the industrial fatigue research board, a newly organized body under the chairmanship of Professor Sherrington. The board will continue in part the activities begun by the health of munition workers committee, which has ceased to exist.

Professor Anton Julius Carlson, chairman of the department of physiology at the University of Chicago, now captain in the Sanitary Corps, is reported to have landed in France at the end of October, after several months of service in connection with the rationing of American troops at the rest camps and in the aviation squadrons throughout England.

Professors James F. Kemp, Waldemar Lindgren, Joseph Barrell and A. C. Lawson, have been at Bingham, Utah, preparing evidence in connection with mining litigation.

Professor J. H. Lahee has resigned from the Massachusetts Institute of Technology to become geologist for the Sun Oil Company in Dallas, Texas.

H. W. Turner has recently made a geological reconnaissance of the Peace River oil field in northern Alberta.

Miss Mary J. Hogue, formerly a member of the zoological staff of Wellesley College, is working in the laboratory of the Base Hospital at Fort Sill, Oklahoma.

Mr. George W. Morey, of the geophysical laboratory of the Carnegie Institution, has been given a year's leave of absence and is in charge of the optical glass plant of the Spencer Lens Company at Hamburg, New York.

Professor Bailey Willis, of Stanford University, recently addressed the New York Academy of Sciences on "The physical basis of national development."

Professor Henry C. Sherman, of Columbia University, lectured before the New Brunswick Scientific Society, on November 25, on "Permanent gains from the food conservation movement."

A joint meeting of the New York Section of the American Chemical Society, the New York Section of the American Electro-chemical Society, the Society of Chemical Industry and the Société de Chimie Industrielle was held on Friday evening, December 6, in Rumford Hall. The program of the evening consisted of the following addresses, accompanied by lantern slides: Colonel William H. Walker,

Chemical Warfare Service, "The manufacture and use of toxic gases;" Colonel Bradley Dewey, Chemical Warfare Service, "The manufacture of gas defense apparatus."

Dr. Etienne Burnet, of the Pasteur Institute, Paris, surgeon in the French army and member of the Mission of French Scholars to the United States, delivered a lecture at the New York Academy of Medicine in cooperation with Columbia University, November 15, on "Pasteur as a representative of the French scientific spirit."

A recent meeting of the Biological Club of the University of Chicago in memory of Samuel Wendell Williston, former professor of paleontology in the university, Dr. Stuart Weller, of the same department, gave an appreciation of Dr. Williston's work. A Williston memorial meeting will be held in Leon Mandel Assembly Hall on December 8, the speakers being Professor E. C. Case, of the University of Michigan, and Professors Stuart Weller and Frank R. Lillie, of the University of Chicago.

Professor George F. Atkinson, head of the department of botany at Cornell University since 1896, died suddenly on November 14, at the City Hospital in Tacoma, Wash. Professor Atkinson was engaged in a field study of the mushroom flora of the Pacific coast at the time of his death.

Dr. Pierre de Peyster Ricketts, for thirty-two years connected with the teaching staff of Columbia University, died on November 20 at his home in New York City. He was born in Brooklyn seventy years ago, was graduated from the School of Mines, Columbia, in 1871, and received his degree of Ph.D. five years later. He was assistant in the School of Mines for a number of years prior to 1885, when he was appointed professor of assaying, and in 1893 was made professor of analytical chemistry and assaying, retiring in 1900 to become the head of the firm of Ricketts, Inc., mineralogical and mining consulting engineers.

A permanent reserve force upon which the Public Health Service can draw in time of emergency such as that presented by the influenza epidemic has been authorized by the Congress. This consists of officers, none holding rank above that of assistant surgeon general, commissioned by the president for a period of five years, subject to call to active duty by the Surgeon General U. S. P. H. S. When in such active duty they receive the same pay and allowances as are now provided by law for the regular commissioned medical officers in the service. By far the larger part of the reserve to be organized under this act will be on active duty only during times of national emergency, though it will probably be necessary to establish periodic terms of training, so as to better fit the officers for such service. With the passing of the emergency these men will automatically go on the inactive list; always however, subject to call to active duty by the surgeon-general. Detailed plans for the organization, training and assignment of the reserve officers are now under consideration.

Medical journals report that the permanent committee which has been appointed to centralize matters connected with the rehabilitation of disabled soldiers, comprises representatives of all the allied governments. They include Dr. Bourrillon (France), who serves as president of the committee; Dr. Mélis (Belgium), Sir Charles Nicholson (Great Britain), General Bradley (United States), L. March (France), Dr. Da Costa Ferreira (Portugal), and Agathonovitch (Serbia) as vice-presidents. All these hold high military rank. An institute for research has been founded at the headquarters of the committee which is already installed at 102 rue de Bac, Paris. A review is to be issued by the committee. The editor in chief is Dr. Jean Camus, of the Paris Medical School, with Dr. Bourrillon, the president of the committee, and Mr. C. Krug, the secretary general, as the board of directors for the publication. The work of the committee is to include the promulgation of the general principles for rehabilitation of the

disabled, which each country can adapt to its own laws and customs; to group and centralize the data and the lessons learned from experience, and to apply them and aid in every way the mutilated and to extend this aid into the future after the war. By this coordination of efforts each one of the allied peoples will be able to profit by the improvements and achievements realized in any one of them.

The announcement was recently made in the British Parliament by the president of the Board of Agriculture that active steps have been taken with a view to the establishment at Cambridge of an Institute of Agricultural Botany, the primary function of which will be the breeding and distributing of improved varieties of agricultural crops. The plan in question was very fully described by Mr. Lawrence Weaver, of the Board of Agriculture, at a meeting of the Agricultural Seed Association held on July 15. It appears that the new institute will be modelled on the famous Swedish plant-breeding station at Svälof, and that its activities will be to follow two distinct lines, one of which will be purely scientific, while the other will have a commercial outlook. More precisely, the scientific wing will be concerned with the producing of pure cultures of new varieties on the field-plot scale; the economic wing will deal with the growing and distribution on a large scale of these varieties. Presumably, on the Svälof model, the scientific side will oversee the operations of the commercial to the extent of guaranteeing the purity of the stocks distributed by the latter. It is announced that subscriptions towards the establishment of the new institute amounting in the aggregate to upwards of £30,000 have already been received including a sum of £10,000 down and £2,000 a year for five years from a commercial firm and that the Board of Agriculture will provide the necessary buildings and equipment.

The Association of British Chemical Manufacturers has in preparation a directory of British chemical products, and the manufacturers from whom they can be procured. The directory, which will be printed in English, French, Italian, Japanese, Portuguese, Russian and Spanish, is expected to be published before the end of the year.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of the late Andrew Dixon White, Cornell University will receive $160,000 on the death of Mrs. White. It receives many paintings and other objects. Dr. White had already given the university his general and architectural libraries, scientific apparatus, funds for extinguishment of debt, illustrative material and other items, and also his house which cost about $75,000. Yale University, Dr. White's alma mater, receives $5,000 for the endowment of the Andrew Dickson White prizes in history and composition, which were established and have since been maintained by Professor Guy Stanton Ford.

Dr. A. Hoyt Taylor, for nine years professor of physics and head of the department, University of North Dakota, having resigned after a year's leave of absence, to continue his war service as lieutenant commander of Naval Radio Communication, in charge of Atlantic Coast Service, Dr. B. J. Spence, associate professor of physics, has been promoted to a full professorship to be head of the department. Dr. Spence has been at North Dakota for the past eight years. Dr. John W. Cox, professor of pathology and director of the State Public Health Laboratory, University of North Dakota, having resigned to enter the United States Public Health Service, he is succeeded by Dr. Alfred G. Long, of Mankato, Minn., as acting director.

Professor C. L. Dake, of the Missouri School of Mines, has returned to his regular duties, after spending his year's leave of absence as a petroleum geologist.

Alfred E. Day, formerly of the Syrian Protestant College, has been appointed professor of biology in the University of Buffalo.

Dr. Charles Packard, recently instructor in zoology in Columbia University, has arrived in Peking, China, where he will have charge of the work in biology in the Union Medical Col-

lege, the maintenance of which is one of the lines of activity of the Rockefeller Foundation.

DISCUSSION AND CORRESPONDENCE

CONCERTED FLASHING OF FIREFLIES

On a hot and dark evening in the summer of 1915, a camping party sought the rocks near the waters edge on the north shore of Sloop Bay, Valcour Island, Lake Champlain. An intermittent flashing of diffused light was soon noticed in the northwestern corner of the bay between 300 and 350 meters distant. This flashing was somewhat similar to that ordinarily called "heat-lightning," but as it appeared against the base of a cliff something over ten meters high an investigation of the phenomenon was decided upon.

On approaching in canoes, a scene of wondrous beauty presented itself. The light was due to the minature lamps of several thousands of fireflies which were holding festival over what appeared to be a breeding ground. The area involved was about 100 meters in length and extended from near the water's surface to a height of about seven meters. At this locality the bare rock faultscarp which formed a portion of the north wall of the bay was covered with a steep sloping bank of glacial and postglacial deposits and these were well supplied with water through seepage. Moving southwesterly one left the bare portions of the cliff and rapidly passed through various plant communities from lichens and mosses to a small grove of white pines. Above this locality there was also a forest clearing used as a meadow.

At no time over the limited area at the base of the bank could one notice an utter absence of illumination but the lighting of a small cluster of lamps seemed to awaken immediate response from a thousand others, and the illuminated area thus spread from one or more centers until the bank was brilliantly ablaze and suggestive of the myriad lights of some city of fairyland. It was these periods of intense illumination that had attracted the attention of the camping party at a distance so great that the lights from a few scattered lamps seemed to leave the bank in absolute darkness. The same phenomenon was also observed on the following evening.

After reading Dr. Edward S. Morse's "Fireflies Flashing in Unison"[1] the writer determined to make another visit to this locality and observe the phenomena more critically. On the evenings of July 11 and 12, 1916. the display was repeated and observed by several visitors. It was impossible to count the number of lamps which were aglow at one time, but the space involved was about 700 square meters in cross section and in some bush-covered places there must have been at least 50 fireflies to the square meter. We should judge that about 10,000 of these insects were present. During these visits we noted that the illumination was never due to a truly synchronous lighting of the lamps of those fireflies engaged in the display but was always of the nature of wave motion spreading out from one or more centers. This spreading moved swiftly from one end of the bank to the other and was particularly beautiful when the light from several centers became confluent, for at that instant the whole bank was very brilliantly illuminated. Strictly speaking there was no *measured* regularity in this concerted response and therefore no *true rhythm*,—such as one may note in the concerted music of certain orthoptera. The repititions were hardly more regular than the cloud illuminations of a distant thunderstorm. There was present the influence of suggestion on what may be called a "mob-psychology" but there was *no special leader*. Any small group could excite a discharge from thousands who were ready to respond. As recovery was rapid, the repititions of the wave-like responses were also rapid.

It is probable that the phenomenon is by no means a rare one and that, in this locality, it is repeated yearly—though the display of 1916 was not quite so brilliant as that of 1915. A display in any place would be compellingly attractive to a passing person only if the festival period occurred during very dark, cloudy or moonless nights. The observer

[1] Science, February 4, 1916.

therefore must happen to be in some lonesome spot without other light, at the proper time of year, under the conditions noted above, and at least after 10 P.M. Even then his observations unless published would not be likely to reach students.

In SCIENCE for July 26, Dr. E. S. Morse gives a brief review of the subject,—with reference to its meager literature. There we find mention of such conditions as "very warm and humid" a "profound calm" following a thunderstorm, "a small clearing" and "stumps" or "trees."

The excessive abundance of fireflies at any one date is no doubt due to climatic conditions that have at first retarded and then hastened emergence from the pupa state. The fact that so many of these insects should occasionally be crowded into limited areas may be due to favorable ground conditions involving moisture; open spaces (where the light signal may be seen at a distance); favorable places (trees, bushes, or stumps) for rests from flight;—shelter from winds;—and perhaps the antecedent direction and strength of such winds. The Valcour Island locality seems to fulfill these conditions and in addition has a large sheltered area, the waters of the bay, across which the light may be seen but on which there is no resting place.

Whether or not the flashes occur in strict unison and whether or not the sequence of recurring responses is a measured one, and so strictly rhythmic, are questions which must be answered through more careful observation of the phenomena. Mr. Nylander, quoted by Dr. Morse, says "The flashes were not so regular as an army officer would like to see in regimental drills but were so rhythmic that any one would take note of their action." In other words, the concerted flashes did not recur with measured regularity but the repetitions were frequent enough to attract attention. How loose a meaning in this discussion do we wish to give the word "rhythm"? Dr. Morse quotes Mr. Pursell as stating "To the best of my recollection the illuminated period lasted about two or three seconds and the dark period perhaps twice that long." A space between the beginning of one flash and the next which could vary from six to nine seconds would in no sense be rhythmic and even if the repetitions occurred with regularity, once every six seconds (the shortest time Mr. Pursell's "recollection" allows), the rhythm would be in very slow, "largo" tempo. Note however in Mr. Morse's quotation that the "several thousand insects in each" of two trees "perhaps a hundred feet apart," "flashed in synchronism. first one tree lighting up and then the other." Here we have the element of response which was so marked in the Valcour Island display. In the latter locality there were several trees and bushes on which rested groups which responded to each other and, at close range, the intervals between group flashings were usually but fractions of a second. The brilliant blazing of the whole bank occurred at intervals varying from a few to many seconds in length—hence the similarity, when seen from a distance, to heat lighting.

If it is desired to get a body of men to sing or play together in perfect rhythm they not only must have a leader but must be trained to follow such a leader. Imagine the difficulty of keeping together on "Old Hundred" if the notes were started with an interval so long as six or nine seconds between each. Do these insects inherit a sense of rhythm more perfect than our own?

Would not a more critical observation of one of Mr. Pursell's trees have shown him that one or more leaders started the flash and that the others "fell in" as in applause;—that the lighting of a tree gained at first in brilliancy and that the light also faded away gradually and not at once. At least this is what was noticed in the four different displays on Valcour Island.

We would ask observers to note the conditions resulting in such local congregations of these insects; to note critically whether the flashings are of the nature of exact unisons, or whether they spread out from small centers, first lighted, and so partake of a rapid but wave-like response to an initial stimulus; and to note also if the sequence of the flashings from the same group is one involving equal

time intervals and so strictly rhythmical in character.

GEORGE H. HUDSON

PLATTSBURGH, N. Y.

ALLEGED REDISCOVERY OF THE PASSENGER PIGEON

IN SCIENCE for November 1 is a communication under the caption "Alleged rediscovery of the passenger pigeon," in which the statement is maintained that a flock of this supposedly extinct bird was recently seen in New York state. Among other observations offered in support of the identification, mention is made of "the whistling sound of their wings." During the seventies and early eighties it was my privilege to form an intimate acquaintance with the passenger pigeon, seeing many thousands of them, shooting hundreds of them and finding numerous scattered nests in the vicinity of Minneapolis, Minn. The wings of this bird never "whistled," the sound made in taking flight being a flapping or fluttering noise similar to that made by the tame pigeon. A flock in rapid flight made a rustling or swishing sound as it passed through the air. On the other hand it is a well-known fact that the wings of the mourning dove produce a loud characteristic "whistling sound" as it launches itself into the air and until it gets well under way. Among pigeon hunters in the old days, this was a commonly recognized distinguishing feature between the two species when other means were obscured.

In and about a "buckwheat field" is an ideal place for an assemblage of mourning doves. Passenger pigeons also fed on grains of various kinds, chiefly wheat and oats, but their favorite food was thin-shelled nuts, largely acorns here in the north.

In view of the fact that no reports of the passenger pigeon from experienced ornithologists have been received for a considerable number of years, in spite of persistent search, it would seem as though this bird must be regarded as an extinct species.

THOS. S. ROBERTS

ZOOLOGICAL MUSEUM,
UNIVERSITY OF MINNESOTA,
November 20, 1918

DEMONSTRATIONS OF VISUAL PHENOMENA

PURKINJE EFFECT

IF a color wheel with a reddish and a bluish color be spun in the light of a strong lantern, and then slowly have its plane turned until the incidence of the light is just grazing, the Purkinje effect is at once demonstrated to a class. As the angle of incidence changes from normal to grazing, the intensity of illumination is reduced to zero, and the red becomes invisible. The effect of this is in general to change the apparent color of the disc through a series of very pretty shades.

PERSISTENCE OF VISION

This is easily shown to a class by means of a lantern, with a slide bearing some letters. Instead of imaging the slide on a white surface, the image should be absorbed by black velvet or the image may be formed in an open doorway. Now move a fairly white stick vertically down in the plane of the image. Different portions of the image can then be seen on the stick, and if the stick be moved fast enough, the eye sees the entire image easily.

PAUL F. GAEHR

WELLS COLLEGE

USONO

TO THE EDITOR OF SCIENCE: In connection with the discussion in your columns as to a more specific name for our country than "America," it may be interesting to note that the advocates of the international language, Esperanto, solved this problem so far as they were concerned quite a while ago, by the adoption of the name "Usono." This is the substantive form of the expression US o NA., composed of the initial letters of this nation's full designation. Usona is, in Esperanto, the adjectival form.

In a rather hasty and superficial glance through the back files of Esperanto publications, I find the word used, either in the text or in date lines, titles, etc., in various magazines, books and pamphlets issued in England, France, Germany, Poland, Switzerland,

etc., including America, under different dates running back to April, 1908. That it was in good standing then is shown by its inclusion in a dictionary published in that year. An extended search would no doubt develop a prior appearance.

This is adequate proof that the word Usono, as a designation for these United States, has been in active service for more than ten years, so that to-day Esperantists throughout the world are entirely familiar with the term, which is tantamount to saying that it is already used and understood in every country of any importance upon the globe.

J. D. Hailman

Pittsburgh, Pa.

SCIENTIFIC BOOKS

MILITARY GEOLOGY AND METEOROLOGY

The publication of the little book on "Military Geology and Topography" which has just been issued by the Yale University Press, furnishes a useful reader in the subject for classes of the student army training courses and represents still another change due to the war—the introduction of the geologist as an integral part of a military organization.

The text, which has been prepared under the auspices of the Division of Geology and Geography of the National Research Council, is intended to give, as its title page states, a presentation of certain phases of the subjects as they are related to military purposes, and as such will prove useful in the classes for which it was prepared. It is not a text-book of geology in which the subject-matter is developed genetically as is customary in cultural or technical collegiate courses, but is essentially an empirical résumé of certain geological phenomena for prospective army officers. For example, streams are treated from a hydrographic viewpoint apart from their influence in the development of land forms and the discussion of rocks is free from detailed tables of classification and extended descriptions of igneous rocks.

The manuscript represents the cooperative work of a number of different men, authorities in their respective subjects, under the editorial supervision of Professor Herbert E. Gregory, who were called upon to prepare their respective contributions with utmost expedition in the midst of other distracting duties. Under such circumstances the product is highly creditable to both authors and editor though it is natural to expect evidence of hurried writing, lack of logical coherence, and overlapping of treatment—faults which have been eliminated with greater or less success by the self-sacrificing work of the editor.

The book includes chapters on Rocks and Other Earth Materials, Rock Weathering, Streams, Lakes and Swamps, Water Supply Land Forms, Map Reading, the Military Use of Minerals. It is well printed, indexed and generously illustrated.

On account of differing methods of treatment incident to the aims and composite authorship, teachers who use the book with S. A. T. C. classes, composed of students of widely different training, may find some difficulty in using it as a text-book for class-room work but students and teachers alike will find it very helpful in conjunction with lectures and laboratory exercises and as a compendium of illustrations of how geological and topographic knowledge is serviceable in military activities.

An "Introductory Meteorology" planned with special reference to the needs of the Students' Army Training Units has just been issued under the auspices of the Division of Geology and Geography of the National Research Council. The manuscript was prepared by the staff of the U. S. Weather Bureau and the result is a compact and well-illustrated book of 150 pages. It is extremely elementary in character but appears to lay a satisfactory groundwork for the more advanced work at military camps or elsewhere to which it is designed to lead.

Seven pages are devoted to the sources from which data are to be obtained and the composition of the atmosphere. This is followed by twenty-one pages devoted to the instruments

used for measuring the meteorological elements, and while this is well written, it is a question if the space it occupies could not with advantage be utilized for a somewhat fuller discussion of other topics. The order of development of the subject proceeds from a discussion of temperatures, pressure, evaporation and condensation to a consideration of fogs and clouds. This is followed by a brief and purely descriptive account of mirage, rainbows, halos and coronas, the chapter being labelled Atmospheric Optics. Two chapters are devoted to Atmospheric Circulation followed by what seem to be unduly abbreviated chapters on Forecasting and Climates.

A well-selected list of reference works and the international symbols are given in appendices. M.

A GREEK TRACT ON INDIVISIBLE LINES

The development in recent years of the subject of transfinite numbers, of point sets, and theories of the continuum is directing the interest of mathematicians to kindred speculations among the Greeks. Recent historians of Greek mathematics have paid due attention to Zeno's arguments on motion as they are presented in Aristotle's "Physics," but thus far they have given no consideration to a kindred tract included among the works of Aristotle, namely, the "Indivisible Lines" or "De lineis insecabilibus." Perhaps the reason for this omission lies in the fact that the text as edited by Bekker was for the most part unintelligible. More recent collations of manuscripts, and the translation into English with careful annotations made by H. H. Joachim, of Oxford, render the tract of undoubted value in the history of mathematics.[1] It reveals the arguments on the existence and non-existence of indivisible lines, and on the possibility of constructing a line out of points, as well as those exhibiting the interaction between physical speculation about atoms and the philosophy of geometry—arguments as they were presumably presented in the most celebrated academy of the most cultured city of antiquity. Who can doubt that the divergence of views then held and the perplexing paradoxes advanced discouraged Greek mathematicians from openly using in geometry the conceptions of the infinitesimal and the infinite? Euclid was about twenty years younger than Aristotle and no doubt was familiar with the trend of philosophic thought of his time. Rigor in geometry demanded the exclusison of paradox and mysticism. Notwithstanding Euclid's total abstinence from controversial conceptions, it is evident that the infinitesimal, the indivisible and the infinite continued to command the attention of some mathematicians, as well as of philosophers, for more than two thousand years. We need only mention the title of Cavalieri's famous work, "Geometria indivisibilibus continuorum nova quadam ratione promota," 1635.

The Aristotelean "De lineis insecabilibus" contains five arguments current among the Greeks in favor of the existence of indivisibles; these are followed by twenty-six arguments supporting the contrary view, and twenty-four arguments intended to establish the impossibility of composing a line out of points. Some of these proofs are rigorous. Thus, it is argued that, if indivisible lines exist, they must be of equal length; an equilateral triangle each side of which is an indivisible line has an altitude less than the indivisible. If a straight line composed of an odd number of indivisibles is bisected, one of the indivisibles will be divided. The Greek failure to build a satisfactory theory of the linear continuum as composed of points is due to their application of metrical ideas; the addition of points could never yield length. Aristotle's failure to construct a satisfactory continuum by starting with a straight line

[1] The Works of Aristotle translated into English under the editorship of J. A. Smith and W. D. Ross. Part 2: "De lineis insecabilibus," by H. H. Joachim, Oxford, 1908. We have not seen this tract used in any history of Greek mathematics, but H. Vogt referred to it in an article on the origin of the irrational, printed in the *Bibliotheca mathematica*, 3s., Vol. 10, 1909–10, pp. 146, 153.

and postulating unlimited divisibility lay primarily in his rejection of actual infinity and acceptance only of potential infinity.

If it is one of the aims of mathematical history to set forth the successes and failures of leaders of mathematical thought, then the Aristotelean tract, "De lineis insecabilibus," is worthy of the attention of mathematicians.

FLORIAN CAJORI

UNIVERSITY OF CALIFORNIA

SPECIAL ARTICLES

JURA-CRETACEOUS STONEWORT AND LIMNEAS, SUPPOSEDLY FROM ARKANSAS

PRESERVED in the paleontological collections at Stanford University is a large block of white chert containing spore-cases of stonewort, a siliceous freshwater algæ and moulds and casts of *Lymnea ativuncula* and *L. consortis* White,[1] two pondsnails originally described from the Jura-Cretaceous red beds, variously called the Morrison formation or *Atlantasaurus* zone, at Garden Park, eight miles north of Cañon City Colorado.

The matrix consists of white siliceous material made up of compacted spicules of stonewort. The surface is rusty and roughened from exposure but shows no sign of stream attrition. The specimen is accompanied by a note by J. F. Newson, mining engineer and former Stanford professor, stating that it was one of two large blocks unlike any rock in place in the vicinity, picked up on the J. L. Van Winkle ranch, east ½ section 6, township 5 north, range 16 west, near the Arkansas river opposite old Lewisburg, Arkansas.

If Dr. Newson is correct in supposing that no beds of similar rock outcrop nearby it is thought that the material was carried there or perhaps lost by one of the early exploring expeditions returning down the Arkansas river from Colorado. I have hoped to obtain information on the subject from the distribution of siliceous rocks derived from stonewort remains in this region but they appear to be of such rare occurrences as to have escaped notice.

With the exception of the nutlets the remains of the Estancia stonewort, *Chara estanciana* Hannibal, are desiccated beyond recognition. These resemble the nutlets of the Bear River stonewort, *Chara stantoni* Knowlton,[2] but are nearly round and marked by six encircling spirals.

There are three groups of limneas found in North America, the Abysmal limneas including *Lymnæa* (*Acella*) *haldemani* Binney, the Moss limneas including *Lymnæa* (*Galba*) *truncatula* Müll., *humilis* Say (+ *cubensis* P fr.), *humilis solida* Lea, *obrussa* Say, and *cooperi* Hannibal and the Marsh limneas including *Lymnæa* (*Lymnæa*) *stagnalis* L., *columella* Say, *auricularia* L., *palustus* Müll. and the European *glaber* Müll. The Garden Park limnea, *Lymnæa ativuncula* White, and Cañon City limnea, *Lymnæa consortis* White, belong to the third group.

These species are the oldest true limneas known from North America. *L. accelerata* White of the Morrison beds is perhaps a *Lioplax* or other operculate while *L. nitidula* Meek of the Bear River Cretaceous is a problematic species that has been confused by White[3] with some other Limnea, possibly the Eocene *L. vetusta* Meek.

HAROLD HANNIBAL

SAN JOSE, CAL.

1 White, C. A., Bull. 29 U. S. Geol. Sur., 1886, p. 20, Pl. IV., Fig. 8–9, *consortis*, 10–11, *ativuncula*.

2 Knowlton, F. H., *Bot. Mag.*, XVIII., 1893, p. 141, text fig. 1–3; White, C. A., Bull. 128, U. S. Geol. Sur., 1895, pp. 63, 104, Pl. X., Figs. 14–16.

3 White, C. A., Bull. 128, U. S. Geol. Sur., 1895, Pl. VI., Figs. 1–2 doubtful, Fig. 3 *nitidula*.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

#SCIENCE

FRIDAY, DECEMBER 13, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

PROBLEMS, METHODS AND RESULTS IN BEHAVIOR[1]

INTRODUCTION

IN every field of endeavor it is from time to time advantageous to pause long enough in the ordinary pursuits of the day to take our bearing, trace the course traveled and adjust plans for the future. I have attempted to do this in the field of behavior and I shall present in brief the result of this attempt.

What I have to offer is in no sense a finished product. It should be looked upon rather as the opening of a discussion, a brief exposition of certain ideas which I hope will be criticized from various points of view.

HISTORICAL REVIEW

Before the renaissance no practical problems in behavior were recognized. All activities in organisms, plants as well as animals, were held to be under the control of souls, agents not amenable to law and not subject to experimental analysis.

Descartes early in the seventeenth century came to the conclusion, partly from the results obtained in observations, partly on the basis of philosophic speculation, "that the bodies of animals and men act wholly like machines and move in accordance with purely mechanical laws." Under the inspiration of this idea, Borelli and others undertook to reduce certain reactions to purely physical and chemical or mechanical principles. Somewhat later Ray, Dodart, Du Hamel and others attempted to account for the movements in plants on the same basis. Thus the science of behavior had its origin, and, strange as it may seem, the fundamental problem before it in its youngest days was to reduce reactions to mechanical principles.

The investigators interested in this en-

[1] An address delivered at the Marine Biological Laboratory, Woods Hole, Mass., July 15, 1918.

deavor were enthusiastic and numerous; so-called mechanical explanations were offered for all sorts of reactions, but these explanations were so extremely simple and crude that they soon came to be looked upon as worthless and the mechanistic concept of behavior fell into disrepute resulting in a period of stagnation.

Not until early in the nineteenth century was interest in the reactions of organism revived. During this period numerous observations and experiments were made on plants, all form a purely mechanistic point of view and very encouraging results were obtained. The work on the behavior of animals consisted, however, almost entirely in superficial observations and the collection of anecdotes, mainly concerning reputed marvelous feats performed. The dog and the fox were favorite subjects, but all sorts of animals were dealt with. We have as a result of this work numerous volumes testifying to the interest in the subject. Menault's "Wonders of Animal Instinct," running through five editions, Jesse's "Anecdotes of Dogs," Swainson's "Habits and Instincts," Cough's "Instincts," etc. These anecdotes are all essentially the same in character. Let me illustrate by quoting one from Menault.

"The following has been related by one of our most eminent naturalists, who heard it from a person worthy of credit:

A young lady was sitting in a room adjoining a poultryyard, where chickens, ducks and geese were disporting themselves. A drake came in, approached the lady, seized the bottom of her dress with his beak, and pulled it vigorously. Feeling startled, she repulsed him with her hand. The bird still persisted. Somewhat astonished, she paid some attention to this unaccountable pantomine, and discovered that the drake wished to drag her out of doors. She got up, he waddled out quickly before her. More and more surprised, she followed him, and he conducted her to the side of r pond where she perceived a duck with its head caught in the opening of the sluice. She hastened to release the poor creature and restored it to the drake, who, by loud quackings and beating of his wings, testified his joy at the deliverance of his companion."

It was generally assumed during this period that animals are endowed with mental faculties similar to those in man and the main incentive in all of this work was the inoulcation of humane treatment of animals. The distribution and extent of pleasure and pain in the animal kingdom was the problem of the day. Menault says in his preface: "The marvels of animal intelligence claim now, more than ever, the attention of observers." "We believe that the lower animals possess, in a certain degree, the faculties of man," and Jesse says: "The better the character of the dog is known, the better his treatment is likely to be, and the stronger the sympathy exerted in his behalf."

The "Origin of Species," which as you know appeared in 1859, opened a new field in behavior. Evolution came to dominate every phase of biology, and the evolution of reactions and psychic phenomena came to be the central problem in animal behavior. To the solution of this problem a number of able investigators devoted their energies (Darwin, Lubbock, Bert, Romanes, Preyer, Graber, et al.).

All of these men concluded on the basis of the results obtained that psychic phenomena extend well down in the animal kingdom and some of them even contended that there are indications of such phenomena in plants. Thus they maintained that all organisms are functionally and psychologically interrelated in the same way as they are structurally, and that the mental faculties of man originated in primitive forms.

Whatever view one may take regarding these conclusions, the fact remains that the experimental work of some of the investigators mentioned is of the highest order and the results obtained have been largely confirmed. I should like to refer particularly to Lubbock's ingenious and thorough work on light-reactions in *Daphnia* and color-vision in bees. Critics should always bear in mind that these investigators were interested in the origin and evolution of responses and of psychic phenomena, and not in the mechanics of reactions.

During the latter part of the nineteenth

century students of animal behavior again returned to the problem which dominated behaviorists of the early years of the seventeenth century, namely, the reduction of reactions to mechanical principles. Prominent among these students were Engelmann, Verworn, Loeb and Jennings.

The work of the last three investigators mentioned is in a general way very well known. That of Engelmann, however, seems to have been to a considerable extent overlooked, although it is among the very best that has ever been done in behavior. I should like to refer particularly to his investigations on *Euglena*, published in Pflüger's *Archiv* in 1882, several years before any of the others mentioned began work in this line.

Engelmann finally concluded, after years of searching observations on the relation between physico-chemical phenomena and the reactions in various unicellular forms, that while many of the reactions in these forms are purely mechanical some of them can not be explained without postulating psychic processes. This conclusion may be responsible for the fact that his work has not received the attention that it deserves.

Thus we see that one problem after another has dominated the work in behavior. Reduction of reactions to mechanical principles; distribution of pain and pleasure; the evolution of reactions and psychic phenomena; and again the reduction of reactions to mechanical principles. What has become of these problems? What are the fundamental problems in behavior to-day?

DISTRIBUTION OF PLEASURE AND PAIN

It has often been said that it is impossible to ascertain whether or not animals experience pleasure and pain and that it is consequently useless to attempt to ascertain the distribution of such phenomena in the animal kingdom. In a sense this is true but in this sense it is also true in reference to human beings. Subjective states can be ascertained with certainty by the investigator only as they exist in himself. He can not be certain that your pain is like his pain. All that he can do is to note his actions, including language, during the process of subjective experience, compare these actions with those in other individuals and base his conclusions upon the relation between them.

Precisely the same method is open to him in regard to other organisms, although it is evident that comparison of actions becomes more and more difficult as the difference between the structure of the organisms involved increases. The problem as to the nature and extent of pain and pleasure (feeling or sensation) consequently becomes more and more difficult as one descends in the organic realm.

This problem can, however, not be avoided. The behavior of every individual depends to a large extent upon his conclusion regarding the nature and extent of feelings in the creatures with which he comes in contact. Human society demands a decision of some sort or another regarding the distribution of these phenomena. Witness the work of the anti-vivisection organizations, societies for the prevention of cruelty to animals and charitable institutions everywhere, all built upon and acting upon decisions regarding this matter. The problem then resolves itself into this. Shall we permit human conduct in reference to such an important matter to rest upon judgments based upon evidence casually gained or shall we demand that it rest upon judgments based upon the results obtained in a comprehensive comparative study of the reactions of organisms under experimentally controlled conditions?

Many anti-vivisectionists and members of other anti-organizations who shed copious tears over cats and dogs in our laboratories do not hesitate to sit all day and impale earthworms, crabs and minnows on hooks, and they do not object to the practise in certain tropical regions of turning turtles and cutting steaks from them for a week or more while alive. They assume, of course, that earthworms, crabs, fishes and turtles do not suffer. Are they correct in this assumption or was Brooks correct when, after a lifetime of intimate association with animate beings of all sorts he said: "I try to treat all living things,

plants as well animals, as if they may have some small part of a sensitive life like my own"? Or are those correct who maintain that sensations in all organisms below the upper stratum of human beings are insignificant?

This question can not, at present, be definitely answered and it may never be definitely answered but a comprehensive comparative study of the reactions of organisms bearing directly upon it will unquestionably make it possible to answer it more nearly correctly than can be done to-day.

The field in this line is open. Practically nothing of a thorough going nature has been done in it. Among the best of the works on the lower organisms is that of Norman presented some twenty years ago. Norman showed that the squirming reactions in earthworms to violent stimulation do not constitute conclusive evidence of pain, for the simple reason that when a worm is cut in two the posterior part squirms violently while the anterior part with the brain does not. Reactions in other organisms led him to conclude that there is no satisfactory evidence of pain in any of the invertebrates. But even this work, which, as stated, is among the best, is far from comprehensive and the conclusions are consequently only meagerly supported.

ORIGIN AND EVOLUTION OF REACTIONS AND PSYCHIC PHENOMENA

It has become the fashion among certain ultra-modern psychologists to solve the problem of consciousness by contending that it does not exist. This contention is no doubt largely verbal. The term consciousness is not very specifically defined. It is used loosely by many, and the controversy as to the existence of consciousness is rooted in this fact. What is denied by some is, as I understand it, the existence of an entity capable of action and experience independent of matter. Regarding this I have nothing to say.

Practically every one who is sane, even the modern psychologist, admits that he is aware; he admits that phenomena may have a subjective as well as an objective reference or existence. Whatever else the term consciousness may imply it always implies awareness (subjective experience). As to the actuality of this phenomenon, we are, I believe, more certain than we are about anything else. The origin, the evolution and the nature of awareness, the processes associated with it and its relations to objective reality constitute, in my opinion, the most fundamental problems that confront the human mind, and all available methods of attack should be brought to bear upon them.

The introspection method has been extensively used in the investigation of some of the problems mentioned. This method is, at present, in disrepute and many have abandoned it altogether in favor of the so-called behavior-method. I do not believe that the tendency to entirely abandon introspection is wholesome, although it is of but little importance in reference to the question before us, the origin and evolution of reactions and consciousness, awareness or subjective phenomena. In the investigation of these questions two methods are promising. One might be called the comparative behavior method, the other the method of genetics.

The method of comparative behavior has been and is still being extensively employed. It consists in the comparison under given conditions of reactions in various organisms including man. It is anthropomorphic in its tendencies and owing to this it has been severely criticized both justly and unjustly. This is doubtless due largely, if not entirely, to misapprehensions as to the import of the method.

The method of comparative behavior was used almost exclusively by Lubbock, Graber, Romanes, Darwin and others interested primarily in the evolution of psychic phenomena. These investigators tried to ascertain whether or not this or that animal sees, hears, smells, tastes and feels.

The results obtained led them, as previously stated, to conclude that various animals, besides man, have subjective sensation. And since it was generally assumed that human behavior is, at least to some extent, controlled by subjective states, it was thought that the be-

havior of other animals is also thus controlled. This resulted in the anthropomorphic explanations of reactions current at the time. For example, it was maintained that organisms which are photo-positive go toward the light because they hate darkness or love light, that the moth flies toward the candle-flame to satisfy its curiosity, etc. These explanations have justly been severely criticized, and yet the method is not necessarily at fault.

If human conduct is dependent upon subjective states, and if other animals have such states, is it not altogether probable that their reactions are also dependent upon subjective states? If this is true it is possible to explain in a certain sense reactions in animals on the basis of psychic phenomena. It is maintained, however, that this is putting the cart before the horse, that it consists in attempting to explain the unknown in terms of something still more unknown. With this contention I do not agree, for I hold that every individual knows his subjective sensations better than anything else. The question, then, resolves itself primarily into this. Does conduct depend upon subjective sensations? If it does then it is evident that in the study of behavior it is of the greatest importance to ascertain the distribution of such sensations. But whether conduct is dependent upon subjective phenomena or not, knowledge regarding the distribution of such phenomena is fundamental; for it seems to be the only knowledge that bears upon the problems of the origin and evolution of consciousness.

We judge as to the presence and nature of such phenomena in others almost wholly by comparing their behavior with ours. We know that conscious states in ourselves are accompanied by certain reactions and when we see these reactions in others we conclude that their subjective experience is the same as ours, and by comparing the conclusions thus reached regarding subjective experience throughout the animate kingdom, we formulate conclusions as to the origin and evolution of these phenomena. I realize full well that conclusions based upon such evidence are precarious, but this method is the only method available in the investigations of subjective states in others, and precarious as the conclusions may be they are far more likely to be correct than those formulated without such investigations. We must consequently either abandon this profound problem altogether or proceed along the line indicated.

Aside from its bearing on consciousness the method of comparative behavior has an important bearing on the problems concerning the evolution of reactions themselves and their interrelation, their sequence. In its bearing on this problem comparative behavior is similar to comparative morphology. As comparative morphology yields results concerning the relation between structures in different organisms, so comparative behavior yields results concerning the relation between reactions. It is not primarily concerned in the relation between the environment and the reactions. Its primary interest lies in the relation between the reactions themselves as manifested in various organisms.

In regard to the evolution of reactions, the comparative method in behavior must, however, give way to genetics just as the comparative method in morphology has. In this field we have as yet scarcely made a beginning. It is a virgin field of great promise. I should like to refer to Yerkes's work on mice and McEwen's on Drosophila.

I have pointed out a number of important problems which are dependent for their solution upon the *relations between reactions* and not primarily, if at all, upon the *nature or the mechanics* of the reactions. There are many other problems which can be greatly illuminated by a study of such relations. I shall refer to but one of those, modifiability in behavior including habit formation and learning in general.

Much of the recent work on the behavior of the higher animals centers about this problem, the work of Thorndike, Morgan, Yerkes, Watson, Carr and others. The results of this work have been of inestimable value, practical as well as theoretical, and yet it is based almost entirely upon the relation between reactions. Practically nothing is known regard-

ing the mechanics of the reactions involved, and owing to their extreme complexity little is likely to be known for years to come. I should like to emphasize this point, for there are those who appear to hold that a study in behavior which does not deal with the reduction of reactions to physico-chemical principles has no practical value.

The study of modifiability in behavior should be much extended, especially in the investigation of the lower forms where it has as yet received but little attention, and closely associated with this is the problem of regulation, so clearly set forth by Jennings in the closing chapters of his book on the behavior of lower organisms.

Comparative behavior then, in spite of its anthropomorphic tendencies is valuable in certain lines of investigation, and I hope that what I have said may counteract the strong opposition that has developed against it. However, no matter what may be the immediate object of behaviorists, practically all of them desire to see reactions reduced, as far as possible, to mechanical principles. What has been accomplished in regard to this, and what are the prospects in reference to it?

THE MECHANICS OF REACTIONS

One of the foremost physiologists says in substance: Many reactions have already been reduced to physical and chemical or mechanical principles and all reactions together with all life-phenomena can be thus reduced. Another equally prominent physiologist says: "The attempt to analyze living organisms into physical and chemical mechanisms is probably the most colossal failure in the whole history of science."

How is it that the results obtained by two eminent and practical investigators in the same general field have led them to conclusions so diametrically opposed, the one maintaining that many vital phenomena have been and that all vital phenomena can be reduced to mechanics, the other apparently maintaining that no vital phenomena have been and that no vital phenomena can be thus reduced? The difference in these conclusions is in part, if not entirely, due to different conceptions as to what a reduction to mechanics involves.

Fundamentally all scientific knowledge is the same. It concerns the order of phenomena not the cause of the order. It is rooted in experience and founded upon the conviction that Nature is orderly, that a phenomenon that occurs under a given set of conditions will occur again whenever this set of conditions obtains. All of the scientific laws that have been formulated are merely expressions summarizing the results of experience, and their validity depends upon the extent of the experience. They are in no sense absolute; any and all of them may have to be modified as more experience is gained. To ascertain and to regulate the order of phenomena in nature is the purpose of science.

Mechanics deals with the relation between events or phenomena and changes in the configuration of material systems associated with such events. The reduction of behavior to mechanical principles consists in ascertaining the relation between reactions in animated systems and changes in material configurations within and outside of such systems. In other words, it consists in ascertaining the sequence in series of changes in material configurations ending in reactions. For example, suppose we have an alkaline medium containing paramecia and add a bit of acid, thus inducing avoiding reactions. The substance or material in the alkaline medium has a certain arrangement or configuration. When the acid is added this configuration is changed and this sets up changes in the material configuration within the paramecia which result in a response. That is, we have a series of changes in material configuration ending in a reaction, and similar series of changes precede all reactions.

Now, when the mechanist says that reactions have been reduced to mechanical principles, he probably means merely that some of the changes in material configuration in the series ending in reactions have been ascertained. And when the anti-mechanist says that the attempt to reduce reactions to mechanical principles has been a colossal failure,

he probably means merely that in no such series have all of the changes in material configuration been ascertained. If this is true then both views are doubtless corect; for it can not be disputed that some of the changes in material configuration in series ending in reactions have been discovered in numerous instances, and it can not be demonstrated that all such changes have been discovered in any instance.

Take for example, one of the very simplest, if not the simplest of all responses, changes in ameboid movement. It has been maintained that this reaction is due to changes in surface tension. Similar movements can be induced in inanimate systems. If a bit of potassium bichromate is brought near a drop of mercury in ten per cent. nitric acid the mercury will flow toward the bichromate. This is due to a local reduction in surface tension. This and numerous similar experiments, it is maintained, show that movements in Ameba are due to changes in surface tension. It has, however, recently been demonstrated that changes in surface tension can not produce the force required in certain ameboid reactions. Other factors have consequently been postulated to supply this deficiency. Now this is a perfectly legitimate procedure in scientific investigation. All that I wish to emphasize here is the fact that ameboid movement has not yet been completely reduced to mechanics. Even if it were conclusively demonstrated that every movement and every change in movement in Ameba is directly the result of changes in surface tension, it could still be maintained that the series of changes in material configurations associated with these phenomena is not completely known for such a demonstration would have no bearing upon the problem of the regulation of the movements.

Ameba can move in a homogeneous environment. Consequently, if its movements in such an environment are due to changes in surface tension, such changes are the result of *internal factors* concerning which practically nothing is as yet known. These factors may be purely physical and chemical, but it certainly can not be maintained that it has been demonstrated that they are. For all that is known to the contrary there may be non-material factors, entelechies and psychoids, involved in this regulation. Do not misunderstand me, I do not maintain that there are such factors involved, I merely hold that it has not been demonstrated that such factors are not involved.

In reference to regulation which constitutes the very essence of vital phenomena, we have indeed as yet traveled but a short way on the road toward reduction to mechanical principles, and it is mainly in this region that the anti-mechanist operates.

If we are correct in our analysis thus far, the essential difference between the mechanist and the antimechanist or vitalist is found in the fact that the former maintains that all reactions are completely determined by material configurations, and that all of the changes in such configurations can be ascertained, while the latter maintains that the reactions are not thus completely determined and that the changes in material configurations ending in reactions can be ascertained only in part. Which of these views is correct will be known, if it is ever known, only after every possible sequence associated with reactions has been ascertained. Thus it is evident that the mechanistic and vitalistic programs are, in so far as they pertain to experiment and observation, precisely the same. The mechanist holds that all reactions can be reduced to mechanical principles. Consequently he proceeds to ascertain by experimental methods every possible sequence of phenomena ending in reactions. The vitalists hold that some reactions or certain phases in some reactions can not be reduced to mechanical principles. He also must proceed to ascertain by experimental method every possible sequence of phenomena ending in reactions. For this is the only way he can be certain as to where mechanism breaks down and non-material factors begin to act.

But mechanists frequently maintain that faith in vitalism tends to inhibit experimentation, and that it inculcates superficiality. They maintain that when the vitalist gets into

difficulty he merely calls in some one of his numerous entelechies, psychoids, vital elans and what-nots to settle the matter in place of exerting himself to trace the source of the difficulty to changes in material configuration. There probably is some truth in this contention; but one thing is certain: that is, that not all vitalists are superficial experimentalists and slovenly observers, *e. g.*, Mendel, Müller, De Candolle, Driesch, Haldane.[2] Nor are all who profess to be mechanists proficient investigators.

Personally I do not believe that there is necessarily any essential difference between the mechanistic and the vitalistic doctrines in so far as they may affect investigation in behavior. I do not see how any one, no matter what doctrines he may hold, can fail to believe that some sequence in changes in material configurations ending in reactions have been ascertained, and that more such sequences can be ascertained, and if one believes this and holds that such knowledge is important, he has the same incentive to investigate regardless as to whether he is a mechanist, a vitalist or an agnostic.

The fact that many series of phenomena have in part been ascertained strongly favors the mechanistic view. This doctrine rests on positive experimental results, while the anti-mechanistic doctrine is founded largely, if not entirely, upon negative results. But there are, nevertheless, some difficulties involved in accepting without limitation the mechanistic doctrine. These difficulties, it seems to me, should be more fully comprehended than they appear to be. I shall, therefore, briefly refer to some of them.

It has often been maintained that the object of all scientific endeavor is the control of nature. While many hold that this statement is too strong, that the control of nature is not the only scientific problem worth while, it is quite generally conceded that it is among the most important problems. If the sequence of natural phenomena is known and if the probable sequence can be predicted, human activities, it is maintained, can be so adjusted as to fit in with the sequence of environmental phenomena, so as to reap pleasure and avoid disaster and, moreover, it is maintained that the sequence can be altered at will, and that nature can be made to obey the commands of man. "Truth makes us free," says Brooks in substance, because it teaches us how to adapt our responses to the order of nature and how to alter the order of nature to meet our demands. Man has harnessed the waters and chained the lightning, he has bridged the oceans and conquered the air. Who can say that he has not gained control over nature? But does this not imply freedom and is freedom not absolutely opposed to mechanism? Are we really free or do we merely think we are free?

Mechanism implies,[3] as previously pointed out, that every phenomenon is specifically associated with changes in the special interrelationship of material particles, masses or systems, changes in or states in material configurations, which are absolutely determined by preceding changes or states in material configuration. Consequently, if mechanism holds, every phenomenon, every act of every organism that ever existed, exists now, or ever will exist, is absolutely determined with reference to character, time and place and has been thus absolutely determined from the very beginning. If you can in reality, at any given instant, move your hand either to the right or to the left, mechanism breaks down, for according to the laws of mechanics, if you move your hand to the right, that movement is by the material configuration within and about you absolutely determined with reference to place, extent, duration and time and you could not possibly have moved it to the left at that time.

In discussing the question of design with Gray, Darwin implies that it is nonesense to believe, that when a swallow snaps up a gnat, it was designed that that particular swallow should snap up that particular gnat at that particular instant. It may be nonsense to be-

[2] Haldane should be classified as an anti-mechanist rather than as a vitalist.

[3] The following statements, of course, apply, in essence, to all deterministic doctrines, antimechanistic as well as mechanistic, as for example Driesch's vitalism.

lieve that all this was designed, but if the doctrine of mechanism holds, and Darwin is usually supposed to have been a mechanist, it has been, by series of material configurations which extend back to the beginning of time, absolutely determined for every swallow that ever existed or ever will exist, precisely which gnats he shall snap up and precisely when he shall snap up each particular gnat. If mechanism holds, chance does not exist in the commonly accepted sense of the term, and the statement so often made that this or that structure or phenomenon originated by chance or the fortuitous concourse of atoms indicates that the import of the mechanistic doctrine is not fully comprehended, for according to this doctrine every movement of every atom, every atomic configuration is absolutely determined by preceding movements or configurations and no other movements or configurations are possible.

If mechanism holds without limit, it is idle nonsense to talk about what might have been. The great calamity that has befallen the world, spreading misery as far as east is from west, threatening to ruin civilization, was scheduled before the world was. And if this is true, is it not sheer folly to hold this or that individual. whose every act is absolutely determined, responsible for the calamity? If mechchanism holds, we are merely cogs in a machine, nothing more, and freedom is a sort of epiphenomenon that exists only in the ethereal realms of philosophical speculation. Do not misunderstand me, I do not maintain that no one is responsible for the war; *far from it!*

I do not know to what extent the mechanistic doctrine is valid; all reaction may possibly be absolutely determined by material configurations; but I do know that I act as though I could, in a measure, regulate the order of phenomena about me, and my actions so as to harmonize with this order in such a way as to receive pleasure and avoid pain and disaster. And I believe that in view of the difficulties involved and in the present state of our knowledge, the general acceptance of this doctrine, without restrictions, is not advisable, because I think that, like all fatalistic doctrines, it would perniciously affect human conduct.[4]

Has then the attempt to reduce animate reactions to mechanical principles been a failure? It has been a failure in the sense that all science has been a failure. The purpose of science is to ascertain and to regulate the order of phenomena in nature; to ascertain in series the sequence of changes in material configurations. In no such series have all the changes yet been ascertained and they probably never will be. We know in part and we prophesy in part. Engelmann proved that sudden reduction in illumination causes reactions in *Euglena*, which result in the formation of dense aggregations in strong light. Lubbock discovered certain definite relations between wave-length of light and reactions in *Daphnia* and various other organisms. Verworn found that various animals orient definitely in electric currents. Loeb showed that photic orientation in Eudendrium bears a certain relation to the quantity of light energy received. Jennings demonstrated that weak acids and various other substances induce reactions in *Paramecium*, resulting in the formation of aggregations by the so-called trial and error method. Parker discovered certain definite relations between the rate of vibration in the surrounding medium and reactions in fishes. All of these responses and innumerable others have been to a certain extent reduced to mechanics, for in all of them series of changes in material configuration ending in reactions have been ascertained.

The attempt to reduce animate responses to physico-chemical principles has resulted in evidence which proves conclusively that a great majority of such responsess if not all of them, are at least in a measure mechanically determined. To ascertain the extent of

[4] Many who read this article will doubtless conclude that the author is a vitalist. Such, however, is not the case. He believes that the evidence at hand does not, as yet, warrant a definite conclusion regarding the extent of the validity of either vitalism or mechanism, and he holds with Huxley that "assertion which outstrips evidence is not only a blunder, but a crime."

this determination is, I believe, one of the foremost, if not the foremost problem that confronts the behaviorist of to-day, regardless as to whether he is vitalistically, mechanistically or agnostically inclined. This problem may never be solved. The extent to which reactions are determined by material configurations will probably never be precisely ascertained. But our knowledge concerning this can certainly be greatly extended. Our observations and experiments have thus far been largely qualitative. Indeed, we have as yet scarcely begun to apply quantitative methods. In this direction there stretches out before us a vast unknown region full of great promises and enticing possibilities.

S. O. Mast

Zoological Laboratory,
The Johns Hopkins University

GEORGE JENNINGS HINDE

On the eighteenth of last March Dr. George Jennings Hinde, F.R.S., F.G.S., died, at the age of seventy-nine. No doubt in time some friend or associate of his will write a personal tribute to the man and his work; I can but speak as one who knew him through his published researches, and it is to these that I would call attention in this brief appreciation.

Hinde was a man who saw nature through a microscope. His life was devoted to the study of minute organic remains so that, as he said of himself, when other paleontologists went into the field armed with hammer and chisel to collect large specimens, he took with him only a magnifying lens.

In the early seventies Hinde, having completed his preliminary education in England, came to Canada where he spent seven years at the University of Toronto under Professor H. A. Nicholson. During that period his researches were more primarily geological than paleontological, his most important contributions dealing with glacial phenomena in western Canada, the glacial and inter-glacial strata of Scarboro Heights and other localities near Toronto, and the terraces of Lake Ontario. But while studying these broader geological problems he was already turning his attention to the well-nigh invisible contents of the rocks. Near Toronto he discovered in the Ordovicic strata conodonts and annelid jaws, while in the Devonic of Eighteen Mile Creek, near Buffalo, New York, he discovered the now famous Conodont bed. Later he found similar annelid remains in the Siluric of western England and in the Lower Carboniferous rocks of Scotland.

Shortly after his return to England, he set out for what was then the paleontological Mecca of Europe—the University of Munich. Karl A. von Zittel had been called to the chair of paleontology at Munich in the early seventies and in less than a decade his fame as a teacher and original investigator had spread throughout the world. His first major contribution to science was his monograph on fossil sponges which appeared between the years 1878 and 1880. In this he laid the foundations of the science of paleospongiology, for he introduced the method of microscopic study of the spicules and skeletal structure, a method which had previously been deemed of no value for fossil forms although it was used for recent sponges. Furthermore, on the basis of these microscopic observations, he made a new classification of the whole phylum, redefined the old genera and described a large number of new ones, covering in this way the whole field of fossil sponges, and, finally, he gave an excellent series of illustrations of the spicules, a thing which had not been done before.

It was during this very period, when Zittel was annually publishing contributions on the structure and classification of sponges, that Hinde went to Munich where he rather naturally undertook, for his doctorate dissertation, a piece of work along the lines then being pursued so eagerly at that university. He had brought with him from England a small nodule from the Chalk of Horstead, in Norfolk, and this supplied him with material for his thesis, for, although the nodule measured only about a foot in diameter, it was found to contain thirty-eight species of sponges, all represented by spicules. These species, many of them new, were described and figured by Hinde in a paper published in 1880, entitled "Fossil Sponge Spicules from the Upper Chalk."

The completion of this piece of research on sponges marked a turning point in Hinde's life. From that time until his death, while he at intervals wrote short papers on other subjects, he devoted himself almost exclusively to the description of the fossil sponges of Great Britain. After receiving the degree of doctor of philosophy at Munich, Hinde was asked by the Keeper of the Geological Department of the British Museum to arrange the large collections of fossil sponges. At first it was thought that the task would not be very difficult but, on account of the necessity of making a microscopic study of the spicules of every specimen and of redescribing each species in scientific terms, it was found that a considerable period of time and extra financial support would have to be allowed for the research, and it is gratifying to note that neither appreciation of the value of such work nor money for its carrying on was lacking. As a result, there appeared in 1883 a quarto volume bearing the title "Catalogue of the Fossil Sponges in the Geological Department of the British Museum." But this was no mere catalogue, no mere listing of numbered specimens with a word or two of description, it was a masterly treatment, the first one of its kind in English, on the anatomy, structure, classification and distribution of fossil sponges, accompanied by illustrations of entire specimens and skeletal elements of all of the more important Paleozoic and Mesozoic genera of sponges in Great Britain, and the work was made particularly valuable by the addition of notes on the occurrence of the British species in other European localities, so that one may learn also of the faunal distribution of the sponges and the stratigraphic correlation of their horizons. The types of a large number of species founded by such early workers as Mantell, Toulmin Smith, Phillips and Miss Bennett were refigured and redescribed so that one need no longer rely upon the unscientific protologs and superficial photographs given by these and other authors. Hinde used Zittel's classification and adopted his method of study of spicules throughout the work, giving to the world a monograph which will always remain a standard work of reference. In recognition of his service to science in carrying on these elaborate researches the Geological Society of London in 1882 awarded to Hinde the Wollaston "Donation Fund."

The "Catalogue" was, however, only a rather general work covering the sponges of all periods. Hinde next undertook the detailed study of all British species in successive geologic systems. Thus, in 1887 he published in the Paleontographical Society (Vol. XL., 92 pp., 8 plates) the first part of "A Monograph of the British Fossil Sponges." It was the first treatise in any country to contain a résumé and evaluation of the literature on fossil sponges, two hundred and thirty-two papers and books being cited. In addition, it included a careful discussion of the structure and morphological characters of sponges, as well as a description of the types of spicules, and to-day this remains the only book in English where such features are found adequately described. The remainder of this first part and all of the second part (published in 1888) were devoted to the systematic description of the Paleozoic species of Great Britain and the figuring thereof. In 1893 a similar volume (part III.) was published covering the Jurassic sponges, and it was Hinde's intention to take up the very large Cretaceous fauna in the same way. But, unless this fourth part has appeared within the last year or so and copies of it have not yet reached this country, the monograph has not been completed and the most abundant, the most perfectly preserved of the sponge faunas of Great Britain must wait until some new worker appears to carry on this difficult task in a field where only a specialist of first rank would have the temerity to follow such a leader.

In 1897 Hinde was honored a second time by the Geological Society of London which awarded to him the Lyell Medal with the sum of twenty-five pounds in recognition of his researches in geology and paleontology and especially of his discoveries of fossil sponges and other minute organisms. Previously in 1886, he had been made one of the assistant editors

of the *Geological Magazine*, an office which he held until his death

Among his lines of research other than those on sponges may be mentioned those on the fossil radiolaria from the rocks of Central Borneo, on the borings in the Funafuti Atoll, on the Cretaceous entomostraca of England and Ireland, and on the annelid remains in the Siluric of Gotland and in numerous other formations of the New and Old World. But despite the value of these investigations, Hinde's name will always be most closely associated with the development of the science of palaeospongiology. What Zittel did for fossil sponges as a group, Rauff for the Paleozoic species of the world, Počta for the Cretaceous sponges of Bohemia, Kolb for the Jurassic and Schrammen for the Cretaceous of Germany—all this Hinde undertook and largely completed for paleospongiology in Great Britain. His death not only deprives England of an eminent paleontologist, but it takes from the science of paleospongiology one of its founders—a man who for four decades devoted his time to the elucidation of the diverse problems connected with the anatomy, taxonomy and geologic occurrence of a group of fossils of which practically nothing was known fifty years ago.

Marjorie O'Connell

American Museum of Natural History

INQUIRY OF THE AMERICAN GEOGRAPHICAL SOCIETY FOR THE INFORMATION OF THE PEACE COMMISSIONERS

In September, 1917, as a result of conferences between Colonel E. M. House and President Wilson, Colonel House was authorized to organize forces to gather and prepare for use at the Peace Conference the most complete information possible, from the best and latest sources, for consideration by the Peace Commissioners.

The expenses were provided for from the special emergency fund placed by Congress at the President's disposal.

Colonel House held preliminary conferences with Dr. S. E. Mezes, president of the College of the City of New York; Professors James T. Shotwell, of Columbia University, and Archibald C. Coolidge, of Harvard University, about the broad lines of the work, and its organization, which, after a time, became known officially as "The Inquiry."

It was soon evident that the scope of the inquiry would demand not only a personnel of size and quality hitherto unknown in any such work but headquarters where safety from enemy activity of records and secret documents could be assured. "The Inquiry" has worked in the closest touch with the Military Intelligence Division. There was also needed an already established organization for many kinds of research, mapmaking, etc., which could be immediately utilized. This problem was finally solved when the American Geographical Society placed its building, at 156th Street and Broadway and a part of its staff, including its director, Dr. Isaiah Bowman, at the disposal of "The Inquiry" without cost.

The work from that date, November 10, 1917, got really under way, and has proceeded under careful guard night and day. Such measures were considered vital, owing to experiences at other peace conferences, notably that after the Franco-Prussian war. It was considered necessary, too, to abstain from publication of details of the work of "The Inquiry" until its results were safely on shipboard. A large part of them are now on the way to Europe, and by the time the President, the other peace commissioners and their staffs, together with the twenty-three members of "The Inquiry," arrive in France, the material used will be ready for them. The main body of it left the building of the American Geographical Society in three army trucks on Monday, December 2. Other results of the work are already in Paris, where Colonel House has been arranging the preliminaries of the forthcoming conference.

Similar inquiries have been in progress abroad, notably in France and England. There have been frequent conferences for delivery of material and exchange of views, marked by a spirit of friendly coöperation

throughout. Some of the material from Europe, such, for example, as the complete texts of important treaties signed since the beginning of the war, has never been made public.

Primarily, "The Inquiry" has been a fact study, conducted in a scientific spirit by specialists and scholars, both American and from various European countries affected by the war. In order to give high value to any statement of fact, the inquiry has been entirely independent of any political hypothesis.

"The Inquiry" has had a personnel of about 150 people. Among them are:

Director, Dr. S. E. Mezes, president of the College of the City of New York.

Chief Territorial Specialist, Dr. Isaiah Bowman, director of the American Geographical Society.

Specialist on Economic Resources, Allyn A. Young, head of the department of economics at Cornell University.

Charles H. Haskins, dean of the graduate school of Harvard University, specialist on Alsace-Lorraine and Belgium.

Clive Day, head of economics department at Yale, specialist on the Balkans.

W. E. Lunt, professor of history, Haverford College, specialist on northern Italy.

R. H. Lord, professor of history at Harvard, specialist on Russia and Poland.

Charles Seymour, professor of history at Yale, specialist on Austria-Hungary.

W. L. Westermann, professor of history at the University of Wisconsin, specialist on Turkey.

G. L. Beer, formerly of Columbia University, specialist on colonial history.

Cartographer, Mark Jefferson, professor of geography, Michigan State Normal College.

Roland B. Dixon, professor of ethnography at Harvard.

In addition there are eleven assistants and four commissioned officers of the Military Intelligence Division assigned to the inquiry for special problems on strategy, economics and ethnography. These officers are:

Major D. W. Johnson, Columbia University.

Major Lawrence Martin, University of Wisconsin.

Captain W. C. Farabee, the University Museum, Philadelphia.

Captain Stanley Hornbeck, author of "Contemporary Politics in the Far East."

The above named, together with map makers and other assistants, sailed with the Peace Commission on the *George Washington.*

Passing by the countless details, "The Inquiry," broadly, has covered the following fields:

1. *Political History*—
   (*a*) Historic rights, including suffrage laws.
   (*b*) Religious development and customs.
   (*c*) Rights of minority peoples in composite populations; subordinate nationalities.
2. *Diplomatic History*—
   (*a*) Recent political history related to diplomacy, treaties, etc.
   (*b*) Public law, constitutional reforms, etc.
3. *International Law*—
   (*a*) To lay the groundwork toward bringing the subject up to date.
   (*b*) Study of treaty texts since the beginning of the war.
   (*c*) Geographical interpretation of problems of territorial waters, frontiers, etc.
4. *Economics*—
   (*a*) International: raw materials, coaling stations, cable stations, port works, tariffs and customs unions, free ports, open ports.
   (*b*) Regional: industrial development, self sufficiency, traffic routes in relation to boundaries and material resources, including food, minerals, water power, fuel, etc.
5. *Geography*—
   (*a*) Economic geography.
   (*b*) Political geography.
6. *Physiography*—
   (*a*) Strategic frontiers.
   (*b*) Topographic barriers.
7. *Cartography*—Maps to illustrate every kind of distribution that bears on peace problems, such as: (*a*) Peoples, (*b*) Minerals, (*c*) Historical limits, (*d*) Railways and trade routes, (*e*) Crops and livestock, (*f*) Cities and industrial centers, (*g*) Religions.
8. *Education*—
   (*a*) Status in colonial possessions.
   (*b*) In backward states.
   (*c*) Opportunities of oppressed minorities.
9. *Irrigation*—
   (*a*) Present development.
   (*b*) Possibilities in general reconstruction.

In its latest stages "The Inquiry" had its work centered on territorial matters, so that all the specialists going abroad are territorial specialists, except the direct representatives of

the State Department. Part of the force in international law are already in Europe, including David H. Miller, chairman of the law committee of the State Department.

Every important nationality of Europe and western Asia has had representatives here for conference with "The Inquiry." Authorities native to the affected countries in Europe have lent their aid and have placed at the disposal of the "Inquiry" all sources of information in their native languages. These, together with numerous secret documents and much information hitherto unavailable to scholars, has resulted in a bibliographic collection altogether unique and valuable. It will become part of the records of the State Department.

The cartographic force of the American Geographical Society, greatly augmented by government aid, began a map-making program hitherto without precedent in this country, all work being carefully drawn from the latest and best sources. Maps have been made to visualize not only all manner of territorial boundaries, but distribution of peoples, number and local densities of population, religions, economic activities, distribution of material resources, trade routes, both historic and potential strategic points.

A series of base maps and block diagrams, the most nearly complete series existing, has been prepared by the American Geographical Society, bearing upon all the geographical problems both of the war and the peace which is to follow. This series has been adopted by the War Department and prescribed by its Committee on Education and Special Training for use in all colleges and other centers where units of the Students' Army Training Corps are located, and for use by chairmen of the War Issues Course Groups. Many of these base maps and block diagrams have already been procured by colleges and universities.

Upon these base maps the Peace Commissioners, or others, by use of colored lines, may immediately have a map showing new state lines, ethnic boundaries, a rectified frontier, or a distribution of any sort, and at the signing of the treaty of peace, a complete record of the new map of Europe.

All information gathered by "The Inquiry" has been so carefully classified, indexed and subdivided that it will be instantly available.

The library for the commissioners will also include hundreds of maps and books from the American Geographical Society, from Harvard, Princeton, Haverford College, the Library of Congress and the New York Public Library. These, with the data gathered by the inquiry have been constantly under guard.

The American Geographical Society will prepare, under the supervision of its director, Dr. Isaiah Bowman, a complete history of the work of "The Inquiry." A history of it will also be prepared for the History Board of the War Plans Division of the General Staff of the War Department.

President Wilson visited the headquarters of "The Inquiry" on October 12, on which occasion he registered his name on the wall in the office of the director of the American Geographical Society. Immediately under it are the names of Secretary Lansing, who visited the "Inquiry" on two occasions, and of Colonel House.

During the year there were a large number of other distinguished visitors, including Secretary Houston, Governor McCall and Major Requin, for a time General Foch's Chief of Staff. The last-named, at the time of his visit, constructed a blackboard sketch of the first battle of the Marne, and this, now carefully preserved, has great historical interest.

SCIENTIFIC EVENTS

THE SALTERS' INSTITUTE OF INDUSTRIAL CHEMISTRY[1]

The Salters' Company has during many years given evidence of its interest in the promotion of scientific education and research by the provision of fellowships tenable by post-graduate workers. It has now taken a further very important step in announcing a scheme for the establishment of an institute to be called "The Salters' Institute of Industrial

[1] From *Nature*.

Chemistry." The offices of the institute will be for the present at the Salters' Hall, and the scheme will be administered by a director, who will be selected on the ground of qualifications based on a distinguished academic career in chemistry coupled with extensive technical experience. An Advisory Board composed of representatives of the Salters' Company, the universities, and the Association of British Chemical Manufacturers is also under consideration.

The Company proposes to establish two types of fellowship, for which post-graduate students of British nationality will be eligible whether graduates of a British university or of a university in the United States or elsewhere. They are to be (1) fellowships to enable post-graduate students to continue their studies at an approved university or other institution under the general supervision of the director of the institute, and (2) industrial fellowships to enable suitably equipped chemists to carry on research for any manufacturer under an agreement entered into jointly by the institute, the manufacturer, and the fellow.

It will be observed that the Company does not at present contemplate the erection of any building or the equipment of any laboratory. Its aim is, therefore, somewhat different from that of the founders of such estalishments as the Davy-Faraday Laboratory attached to the Royal Institution in London, or the Kaiser Wilhelm Institute opened in 1912 near Berlin. The intention is to add to the number of first-rate chemical technologists available for the service of industry in this country, a class of men which at present scarcely exists and is sorely needed. It is hoped to offer such attractions to some of the best students that on completing their university course they will seek to apply their knowledge to manufacture and industry generally, and that employers will recognize promptly the necessity for such assistance so that openings for such men with suitable remuneration will be provided concurrently with the supply. Hitherto almost the only career available for the honors graduate in chemistry has been in connection with the teaching profession. Probably in future such men will be divided into two classes according to their personal predilections, some going to the works, while others will prefer teaching. In both directions the opportunities provided have been insufficient in number and inadequate in remuneration, so that many cases have occurred in which a man with distinct scientific gifts has been forced by circumstances to seek employment in other directions, and science has been consequently the poorer.

The fundamental idea which has inspired the Salters' Company may be illustrated by one or two examples. Suppose a man to have taken his degree with distinction in chemistry, and in physiology as a second subject. Elected to a Salters' fellowship, he may undertake a research on some subject of a biochemical nature. This may be carried on at his own university or at any other possessing a special school for this class of work in England or some other country. In due time arrangements may be made by the director for the fellow to take a course of chemical engineering, perhaps in America, and afterwards to obtain technical and industrial experience. In a very short time a man so trained and experienced will be in a position to demand, and will certainly be worth, a very high salary. It would be easy to provide a similar course with the necessary modifications adapted to the case of a man whose original bent is in the direction of physical chemistry or pure organic or metallurgical chemistry. The printed scheme issued by the Salters' Company gives no information as to the pecuniary value of the proposed fellowships. In estimating the annual amount which should be assigned to each fellowship, it must be remembered that the holder, while required to live simply and carefully, must be free from difficulties about books, traveling expenses and laboratory outlay. Probably £300 a year under present conditions and for some time to come will not be found too much, though perhaps expenses will depend to some extent on whether the student remains at home or is required to reside at a foreign university or center. When operations are to commence at the institute will depend

on the discovery of the right man for the office of director, and doubtless he will have a good deal to say about working details.

THE INFLUENZA EPIDEMIC

The Bureau of the Census has supplied the following data concerning deaths from influenza and pneumonia covering twelve weeks ending September 14 to November 30, inclusive.

Cities in Order Affected	First Week	Maximum Week	Week when Death Rate (all Causes) Reached Normal Level	Deaths from Influenza and Pneumonia (all Forms)	
				Number	Number for 1,000 Population
Boston	Sept. 14	4th	10th	4,510	5.7
Worcester	" 21	"	9th	919	5.3
Lowell	" 21	"	8th	534	4.9
Fall River	" 21	"		704[1]	5.5
Providence	" 21	5th	10th	1,086	4.1
New York	" 21	6th		21,314	4.1
Cambridge	" 28	2d	7th	504	4.5
Syracuse	" 28	4th	9th	915[1]	5.7
New Haven	" 28	5th		783[1]	5.1
Washington	" 28	4th	8th	2,082	5.2
Jersey City	" 28				
Pittsburgh	" 28	7th		3,710	6.3
Philadelphia	" 28	4th	9th	13,025	7.4
Indianapolis	" 28	"		584[1]	2.0
Chicago	" 28	5th		9,133	3.5
Buffalo	" 28	"	9th	2,293	4.8
Baltimore	" 28	4th		3,812	6.4
Milwaukee	" 28	5th		821	1.8
Minneapolis	" 28	"		671[1]	1.7
Birmingham	" 28	"	7th	622	3.1
Newark	" 28	"		1,873	4.4
Richmond	Oct. 5	3d		667	4.2
Kansas City	" 5	5th		1,085	3.5
New Orleans	" 5	4th		2,134	5.6
Denver	" 5	"		962	
Louisville	" 5	"	7th	735	3.0
Columbus	" 5	"		526	2.3
Cincinnati	" 5	"		1,280	3.1
Nashville	" 5	3d		620	5.2
Atlanta	" 5	4th	5th		
Los Angeles	" 5	5th		1,877	3.3
Cleveland	" 5	"		2,686	3.3
Albany	" 5	4th	8th	592	5.3
Memphis	" 5	3d	7th	534[1]	3.4
Omaha	" 12	2d		527[1]	2.9
St. Paul	" 12	6th		624[1]	2.4
Seattle	" 12	3d		703	
Dayton	" 12	"	6th	533	4.1
Rochester	" 12	"		808	3.1
St. Louis	" 12	4th		1,714	2.2
Oakland	" 12	"		702[1]	3.3
Grand Rapids	" 12	6th		128[1]	0.9
Spokane	" 12	3d		233[1]	
Portland	" 12	4th		676	
San Francisco	" 12	"		2,247	4.7
Toledo	" 12	3d		523	2.0

1 Deaths for eleven weeks only.

THE RETURN OF CHEMISTS TO THE INDUSTRIES

When the United States entered the European war one of the first problems to be considered was the effect of the draft upon our essential industries. It was early appreciated that in order to maintain our full efficiency it would be necessary to conserve as far as possible our skilled workers and men with technical training. In order that we might not suffer from the depletion of our ranks, steps were taken to secure deferred classification, and later on provision was made to furlough back to industry. This arrangement made it possible for chemical industries to maintain their efficiency and has contributed largely to the effectiveness of our forces in the field.

Up to the time of cessation of hostilities the Industrial Relations Branch of the Chemical Warfare Service had recommended for deferred classification 641 chemists and skilled workers. These recommendations were favorably considered, as a rule, by the local boards, and as a result about 90 per cent. of the men so recommended were put in a deferred class.

Many cases, however, were not brought to the attention of this branch until the men had actually been called into service. Such chemists or skilled workers as were essential to industry were then furloughed in order that the production of war materials might not be retarded. Through this method 156 men had been returned to industry, and at the time of the signing of the armistice 120 more cases were pending in the Adjutant General's office.

As hostilities cease we naturally must again turn to peace-time conditions and look forward to the future development of chemical industry in America. The problem now before the Industrial Relations Branch of the Chemical Warfare Service is to assist chemists in service to secure positions where their training and experience can be used to the best interests of the government. This enormous readjustment is rendered possible through the information gathered by Dr. Charles L. Parsons, secretary of the American Chemical Society, and through the questionnaires sent out by Major

F. E. Breithut, of the Personnel Division of the Chemical Warfare Service.

In order to accomplish results the chemists now in military service who desire to return to chemical industry are being requested to inform the chief of the Industrial Relations Branch concerning their future prospects, while the manufacturers are being asked to designate their requirements for chemists. The administration of this work will be carried out by the Industrial Relations Branch. Any information desired may be obtained by writing to Major Allen Rogers, Chief, Industrial Relations Branch, Chemical Warfare Service, 7th and B Streets, N.W., Washington, D. C.

THE AMERICAN PSYCHOLOGICAL ASSOCIATION

After the signing of the armistice, the council reconsidered its vote not to have a meeting this year. It has been definitely decided to hold a brief and somewhat informal meeting at Baltimore. The Baltimore meeting will be held on Friday and Saturday, December 27 and 28. The sessions will take place in Gilman Hall, Homewood, Johns Hopkins University. Sections H and L of the A. A. A. S. will meet in rooms in the same building.

The program has been limited to papers upon psychological work in connection with the war. Owing to the short time at the committee's disposal, it has asked a number of members in service to present papers, instead of following its usual custom of sending a general notice to the members of the association. A number of members have already consented to read papers, and the meeting promises to be an interesting one. The general scheme for the program is as follows: Friday, December 27, at 10 A.M.—a parallel session with Sections H and L; Friday afternoon—a joint session with Sections H and L; Friday at 6:38—the annual dinner followed by a business meeting and smoker; Saturday morning at 9:30—a joint session with Section H; Saturday afternoon—a symposium upon "The future of pure and applied psychology." Friday at 4:30 P.M., Professor E. L. Thorndike, the retiring vice-president of Section H, A. A. A. S., will deliver an address entitled, "Scientific personnel work in the U. S. army." At 7:30 P.M., Professor E. F. Buchner, the retiring vice-president of Section L, will deliver an address entitled, "Scientific contributions of the Educational Survey." Among others, will be papers upon the work of the psychological examiners, upon the methods of the Committee on Classification of personnel including the trade tests, upon the work of reconstruction and upon the investigations in connection with aviation. It will not be possible this year to send a complete program to the members before the date of the meeting. All members are invited to attend the smoker, whether they are present at the dinner or not.

H. S. Langfeld,
Secretary

Harvard University,
December 4, 1918

THE YELLOW FEVER EXPEDITION OF THE ROCKEFELLER FOUNDATION

Dr. George R. Vincent, president of the Rockefeller Foundation, announces that with the cessation of hostilities in France the foundation is prepared to direct its activities, largely diverted into war channels, back into ways of peace. Its international health board, he said, would renew at once in cooperation with local authorities in South and Central America its combat against yellow fever.

Dr. William C. Gorgas, retired from the post of surgeon general on account of age, soon will sail, to take charge of the foundation's fight against yellow fever. The position of director of yellow fever work, which General Gorgas now occupies, he held until the war compelled him to relinquish it and the foundation to suspend its efforts. Dr. Vincent's statement continues:

> Dr. Gorgas will sail within a short time for Central and South America. Dr. N. E. Connor has already preceded him to Guayaquil, on invitation of the government of Ecuador. He will guide the local operations, which will be done by men appointed by the local authorities.
>
> The program which General Gorgas will now actively develop, results from a study of the yellow fever problem by the International Health board, which began its labors in July, 1914.

The opening of the Panama Canal, with the establishment of new world trade routes, brought the danger of a wide distribution of yellow fever. Its appearance in Asia, for example, would be a catastrophe.

To obtain authoritative information and counsel, the board appointed a yellow fever commission, headed by General Gorgas. Associated with him were Dr. Henry R. Carter, of the United States Public Health Service; Dr. Juan Guiteras, chief health officer of Havana; Major T. C. Lyster and Major E. R. Whitmore, of the Medical Department, United States Army, and Mr. W. D. Wrightson.

To define the problem accurately, the commission, in the spring and summer of 1916, visited all countries in South America in which yellow fever had appeared in recent years. On its return it presented a report, expressing the opinion, in which all members of the commission concurred, that the total eradication of yellow fever was feasible.

In January, 1917, the board adopted a working program and appointed Dr. Gorgas director. The Secretary of War had agreed to release the surgeon general for this service, but the war compelled a postponement of the work which is now to be resumed.

SCIENTIFIC NOTES AND NEWS

Raymond Dodge, professor of psychology in Wesleyan University, has been made lieutenant commander in the United States Navy, in recognition of the special psychological tests devised by him for the use of the Navy during the war.

Dr. Charles S. Venable is a captain in the Development Division of the Chemical Warfare Service doing gas offense work in Cleveland.

Professor E. C. Franklin, of Stanford University, is on leave of absence and is engaged in research work near Washington for the Nitrate Division, Ordnance Department of the Army.

Eight American engineers have sailed for France to attend the French Engineering Congress in Paris to study reconstruction in France and restoration of French industries. An invitation to send representatives to the meeting was received by the American Society of Civil Engineers from the French Society of Civil Engineers, and the American organization invited representation from the national societies of civil, mechanical, electric and mining engineers. The members of the delegation are: George F. Swain, Nelson P. Lewis, George W. Fuller, A. M. Hunt, George W. Tillson, Major James F. Case, L. B. Stillwell and E. Gybbon Spilsbury.

Dr. Astley P. C. Ashhurst, of Philadelphia, who went to France as a major in command of Base Hospital No. 34, unit of the Episcopal Hospital, has been promoted to the rank of lieutenant-colonel and placed in charge of all the hospitals in the Mantes Sector. His place as director of Base Hospital No. 34 has been taken by Dr. Emory G. Alexander.

Major J. C. Fitzgerald, director of Connaught and Antitoxin Laboratories, University of Toronto, is at present with the Royal Army Medical Corps, as officer-commanding, No. 39 Mobile Laboratory, France, and acting also as adviser in pathology.

Dr. I. M. Lewis, formerly chairman of the school of botany in the University of Texas, is now a captain in the Sanitary Corps, stationed at Yale University. He is in charge of the preliminary course given to officers in training at Yale University.

Lieutenant Alvin R. Lamb, of the Division of Food and Nutrition, Medical Department, U. S. Army, is now stationed at Camp Greenleaf, Ga. He is on leave of absence from the Iowa Agricultural Experiment Station.

Lieutenant Ralph Benton, Inf., U. S. A., formerly associate professor of zoology in the University of Southern California and more recently of the United States Bureau of Biological Survey, has been assigned as personnel adjutant at the College of the Pacific, San Jose, Calif.

The following men, formerly members of the scientific staff of the Bureau of Biological Survey, U. S. Department of Agriculture, are now engaged in rat-control work in connection with the Sanitary Corps of the American Army in France: Major Edward A. Goldman, in charge, assisted by Lieutenants Francis Har-

per, Joe G. Crick and Joseph Keyes, and Sergeant Remington Kellog.

Dr. Kenyon L. Butterfield, president of Massachusetts College and member of the Army Educational Commission for Vocational Training, has sailed for France to begin work in the overseas schools which are to be open to soldiers until they return home.

Dean Hayward, of the Agricultural Department of Delaware College, has been given a leave of absence for a year to serve as a regional director of agricultural education in France, under the Y. M. C. A. army overseas educational commission.

Professor Harry Fielding Reid, of the Johns Hopkins University, and Professor Stephen Faber, of the University of South Carolina, have gone to Porto Rico, at the request of the Secretary of War, to study the severe earthquakes which did serious damage in that island in October.

Dr. Edgar W. Olive, curator at the Brooklyn Botanic Garden, spent several weeks during the past summer for the Plant Disease Survey and Cereal Disease Office of the United States Department of Agriculture, in cooperation with the departments of plant pathology of the New York State Agricultural College, Cornell University, and the Virginia Polytechnic Institute. The work included a fruit disease survey of the counties in the Hudson River valley; a study of onion smut conditions in the Wallkill valley, Orange county, N. Y.; an oat and barley smut trip through the Hudson River valley counties, and a study of a new wheat disease in western Virginia. This work was continued during October, Dr. Olive being in Pennsylvania from the first to the fifth of the month, making a survey and study of a new and descriptive potato wart disease.

Dr. Orlando E. White, curator of plant breeding at the Brooklyn Botanic Garden, was granted a leave of absence of three and a half months, beginning on August 1, 1918, for the purpose of cooperating with the federal government in the study of various problems connected with the growth and utilization of the castor oil bean, with special reference to the production of castor oil. Plantations were visited in Tennessee, Arkansas, Georgia, Florida and Texas.

Mr. G. W. Gray, of the Midland Refining Company, El Dorado, Kansas, has been appointed a director of the Bureau of Refining, Oil Division, U. S. Fuel Administration.

Professor E. K. Soper, of the Oregon State School of Mines, has returned to Corvallis, Oregon, after three months of geological work in the Atlantic Coast and Great Lakes States.

Dr. W. W. Bonns has accepted a position as director of the botanical research department of Eli Lilly Co., pharmaceutical chemists, Indianapolis.

J. R. Bailey, professor of organic chemistry in the University of Texas, who spent last year doing research work with the Hirsch Brothers in New York, has returned and resumed his duties at the university.

Dr. C. Stuart Gager, director of the Brooklyn Botanic Garden, delivered the commencement address at the School of Horticulture for Women, Ambler, Pennsylvania, on December 13, 1918. The subject of the address was "Horticulture as a profession."

At the recent opening at the South Baltimore General Hospital Dr. Llewellys F. Barker, of the Johns Hopkins University, and Dr. Jane E. Nash, superintendent of the Church Home and Infirmary, made the principal addresses.

The anniversary address of the New York Academy of Medicine was delivered on December 5, by Edwin G. Conklin, professor of biology in Princeton University, on "The biology of democracy with especial reference to the present world crisis."

Over £2,500 of the £12,000 required has been subscribed to the chair of medicine which is to be established in the University of Belgrade, as a memorial to D. Elsie Ingles.

Dr. Sidney Augustus Norton, emeritus professor of chemistry at Ohio State University since 1895, has died at his home in Columbus, aged eighty-four years. He was one of the five members of the original university

faculty appointed in 1873, of whom two—Dr. Tuttle, of Virginia, and Dr. Mendenhall, of Ravenna—now survive.

The temporary officers of the American Association of Clinical Psychologists have deemed it advisable to hold the annual meeting scheduled for December, 1918. The temporary officers of the association are as follows: Chairman, J. E. Wallace Wallin; Secretary, Leta S. Hollingworth; Committee on Constitution, Leta S. Hollingworth, David Mitchell and Francis N. Maxfield; Committe on nomination of officers and new members, Rudolf Pintner, Helen Thompson Woolley and H. H. Goddard.

During the past summer, the Gail Borden collection of minerals, belonging to Occidental College, Los Angeles, which had been loaned to the mining exhibit at the San Diego Fair, has been rearranged and placed in a better position for study. This collection containing some of the finest mineral specimens on exhibition in southern California, became the property of the college some years ago and forms the nucleus around which its mineralogical collections are grouped. Additions to these by gift and purchase have been made from time to time so that to-day the collection has representative series of most of the economically valuable minerals, especially those of the west. The collection is open to the public and facilities for study of the specimens will be extended to visiting mineralogists.

UNIVERSITY AND EDUCATIONAL NEWS

A step of much importance to Utah was taken by the Board of Trustees of the Utah Agricultural College on December 2, when they formally established an Agricultural Engineering Experiment Station as an integral part of that institution. Under the plan of organization there will be five experimental divisions of the new station under the following personnel:

Irrigation and Drainage: Dr. F. S. Harris and Professor O. W. Israelsen.

Roads: Professor Wm. Peterson and Ray B. West.

Farm Machinery and Transportation: Professor L. R. Humphreys.

Manufacture of Agricultural Products: Dr. M. C. Merrill and Professor J. C. Thomas.

Rural Architecture and Buildings: Professor R. B. West.

The governing board of the Sheffield Scientific School, Yale University, has decided, without a dissenting vote, to recommend the establishment of a four-year course in place of the present three-year course.

Dean E. A. Birge, professor of zoology, will continue to act as president of the University of Wisconsin until a successor is elected to the late President C. R. Van Hise.

Dr. Horace D. Arnold has been appointed director of the Harvard Graduate School of Medicine; Alexander S. Begg, dean, and Charles L. Scudder, acting dean. The other members of the administrative board chosen are: Drs. David L. Edsall, George G. Sears, Algernon Coolidge, Ernest E. Tyzzer and Francis W. Peabody.

Professor C. A. Wright, of the Iowa State College, has been appointed professor of electrical engineering, in the College of Engineering at Ohio State University.

DISCUSSION AND CORRESPONDENCE

A LEAGUE OF NATIONS

To the Editor of Science: Allow me to call the attention of your readers to the statement below, regarding a League of Nations.

Until a month ago the best that we could do was to "win the war." Now that the war is won, let us remember that it has been won for peace; and let us therefore do our utmost to prevent the recurrence of anything so utterly wasteful, so inanely unscientific as warfare as a means of settling international disputes. Is it not indeed unthinkable that we should again attempt to settle differences by a method, in which the demonstration of rightfulness consists so largely in discovering which nation or group of nations can kill or starve the greatest number of its opponents, and in which the

discoveries of science are reduced to their most cruel and malevolent application.

While we may not be able to specify the ways in which a League of Nations shall act to maintain peace, let us at least impress upon our government the essential importance of reaching the best possible understanding with other nations as a means of preventing future wars—in other words, the importance of forming the best attainable League of Nations for the maintenance of peace. We can not impress the government to this end in any way better than the truly democratic way of petitioning.

The precise form that a petition in favor of a League of Nations may take is of secondary importance, but it is of prime importance that the great body of public opinion which is so strongly in favor of permanent peace should make itself known to the government, and thus strengthen the purpose of those public servants who have this great end in view.

Let me note that six or more members of the National Academy, present at the Baltimore meeting, being officers in the Army and Navy, refrained from signing the following statement, because officers are not allowed to take part in such matters.

W. M. Davis

Cambridge, Mass.,
December 3, 1918

The undersigned members of the National Academy of Sciences, meeting in Baltimore, November 18, 1918, having petitioned the Congress of the United States to take action, in consultation with the governments of many other countries, toward the formation at as early a date as possible of a League of Nations for the maintenance of peace, hereby urge the members of other learned societies in the United States to do likewise.

Charles D. Walcott, Smithsonian Institution, Washington, D. C.

Arthur Gordon Webster, Clark University, Worcester, Mass.

H. S. Jennings, Johns Hopkins University, Baltimore, Md.

Douglas H. Campbell, Stanford University, California.

Victor C. Vaughan, University of Michigan, Ann Arbor, Mich.

Joseph P. Iddings, U. S. Geological Survey, Washington, D. C.

Waldemar Lindgren, Massachusetts Institute of Technology, Cambridge, Mass.

John M. Clarke, State Museum, Albany, N. Y.

Whitman Cross, U. S. Geological Survey, Washington, D. C.

John J. Abel, Johns Hopkins University, Baltimore, Md.

W. M. Davis, Harvard University, Cambridge, Mass.

Edwin G. Conklin, Princeton University, Princeton, N. J.

Walter Jones, Johns Hopkins University, Baltimore, Md.

W. S. Halsted, Johns Hopkins University, Baltimore, Md.

G. A. Bliss, University of Chicago, Chicago, Ill.

Henry M. Howe, National Research Council, Washington, D. C.

F. L. Ransome, U. S. Geological Survey, Washington, D. C.

Ernest F. Nichols, Yale University, New Haven, Conn.

W. H. Howell, Johns Hopkins University, Baltimore, Md.

EXPERIMENTAL OSMOSIS WITH A LIVING MEMBRANE[1]

It was after an early killing frost some years ago that I cut down the dahlias before the sun could make effective its warmth of the early day. As the sickle passed through one of the large stems, water flowed out of the chamber between two nodes. A somewhat closer inspection revealed that fully half of the large chamber had been filled with water and that part of it had developed into long acicular crystals of ice. I was reminded of the advice given by an expert in dahlia culture, namely that, when the flowering period began, the plants should be given all the water they could stand. Ap-

[1] A personal communication to a former student.

parently, it was in these internodal chambers that the plants stored away what might be designated their reserve water supply. This observation has acquired new significance in the light of the statement made by Atkins that trees store away a supply of water as well as sugar in winter in the dead portions of the woody trunk and that these materials are drawn upon in the early spring for the new growth.

Interesting as this comparison may be in itself, the observation made on the dahlia, together with the peculiar stem structure of this plant, suggested the possible use of the internode with one of the nodes as an osmosis cell where the semipermeable membrane is a live tissue. Hence, I have been wanting to use it as such ever since, but failed to carry out the idea until this morning (October 3, 1918). Having cut down a stem, such a chamber or cell was easily prepared, a dilute salt solution introduced into the cell, the latter capped with a rubber stopper through which a tube was passed down into the cell, and the whole placed into a beaker with distilled water. It did not last long until the salt solution was seen to rise in the tube and at the end of possibly an hour it had risen fully six inches. Before another hour the salt solution had risen to the top of the tube.

A number of possibilities for further experimentation at once suggested themselves, but before going any farther, I thought it advisable to show the experiment to Professor Overton, our plant physiologist. He informed me that, so far as he knew, the experiment was a new one and asked for permission to show it to his class in place of the conventional thistle tube experiment. He called in two other members of the botany department who happened to be passing by. To them also the experiment was new.

Whether I shall be in a position to continue the line of investigation that suggests itself, especially during these times so hostile to research, I have my doubts. Nevertheless the mere possibility of studying osmotic problems, even greatly limited in range, with a living osmotic cell of such convenience as the dahlia internode and node, is stimulating in itself. It will involve not only chemical problems but a careful anatomical study of the tissues as well. Because of the great amount of reserve materials stored away in the roots, it ought to be an easy matter to raise this osmotic cell-producing plant in greenhouse for winter experimentation.

Edward Kremers

University of Wisconsin

QUOTATIONS

FRANCE'S SHARE IN BIOLOGY AND MEDICAL SCIENCE

A course of three lectures on France's share in the progress of science has been delivered at University College, London, by M. Henri L. Joly, professeur des sciences physiques et naturelles au Lycée Français. In the concluding lecture, on November 5, he dealt with biology and the medical sciences, but owing to the wide range of the subject, covering the achievements of at least three centuries, he professed that he could do little more than recite a list of names of greater or less distinction. After references to de Tournefort, Duhamel de Morceau, and Buffon, whom he regarded as a man of letters rather than an exact naturalist, he said that the founder of modern biology in France was Lamarck, who first sought in natural sciences for something beyond description and classification. Xavier Bichat was a pioneer in histology and did much valuable work on the cellular theory. Cuvier was declared to be the greatest of French comparative anatomists, and other naturalists mentioned were Gaudry, one of the early evolutionists; Van Tieghem, to whom very Frenchman studying botany acknowledged a debt; J. H. Fabre, who had done more than any man to popularize natural history in France; Armand Sabatier, the comparative anatomist, and Lecoq, who, the lecturer contended, had anticipated Mendel by twenty years. Turning to Frenchmen whose work had been more particularly in the sphere of medical sciences, after mentioning Mondeville and Guy de Chauliac, M. Joly passed on to the seventeenth century, noting the work of Pecquet on the thoracic duct, of Paris on

ergotism, and of Denys, who performed transfusion of the blood in Paris in 1667. Descartes, who was chiefly known in other scientific connections, did some useful work on visual accommodation, and Lavoisier made a contribution to the chemistry of respiration. He spoke next of Laënnec, of Magendie, who was probably the first experimental pharmacologist; of Le Gallois, who worked on the vagus nerve; of Flourens, who first used chloroform in experiments on animals; of Claude Bernard, who studied the action of the pancreas in diabetes and worked also on the nervous system, and of Paul Bert, his pupil, who organized the teaching of natural sciences in France; of Duchenne, the originator of electrotherapy; of Broca, Charcot, Achard, Dastre, Carrel and others. The work of Pasteur was dealt with in a previous lecture. In concluding, the lecturer referred to the cordial exchange between British and French science which had been maintained for three centuries, save for the interruption of the Napoleonic wars, and said that whenever French scientists had been persecuted by religious bigots they had always found a refuge in England.—*British Medical Journal.*

SCIENTIFIC BOOKS

Medical Contributions to the Study of Evolution. By J. G. ADAMI. New York, The Macmillan Co. 1918.

Professor Adami has brought together in this volume his Croonian Lectures delivered in 1917 and a number of more or less cognate articles and addresses written or delivered at various times from 1892 onwards. The Croonian Lectures, entitled "Adaptation and Disease," form the *pièce de resistance* of the volume and present evidence drawn from bacteriological and medical sources, which, in the lecturer's opinion, indicate that variation in organisms is something "primarily acquired, proceeding from without," rather than something "primarily inherent, proceeding from within." The evidence submitted consists (1) of the effect of changed environment in producing structural or, more especially, physiological modifications in unicellular organisms, such as bacteria and (2) the effects of immunization in producing physiological modifications of organisms, shown by their increased powers of resistence. In both these classes of cases definite conditions primarily external produce definite modifications and these may therefore be regarded as acquired.

In collating data on the origin of variation from sources that are not always familiar to those whose studies lie in other fields Professor Adami has done good service, but unfortunately, he combines with this a vigorous criticism of biologists in general for having failed to recognize the direct action of toxic substances on the germ cells or that of the environment on unicellular organisms. Far from being "shocked" at the suggestion of such ideas biologists have all along accepted them, even Weismann, who seems to be regarded as the *fons et origo* of "academic" biology; indeed, Professor Adami in an address of 1892, reprinted in the present volume, cites from Weismann a statement as to the effect of the environment on protozoa, which might well have been repeated in the lectures. Nor should the implication that zoologists have established a conspiracy of silence regarding Professor Gaskell's theories as to the origin of vertebrates be allowed to pass undisputed. Dr. Adami has apparently forgotten that a symposium upon these theories was held as one of the regular meetings of the Linnean Society, Professor Gaskell's work being thus accorded a recognition and an honor granted but rarely. Zoologists have been by no means unappreciative of the merits of Gaskell's observations even though they may have declined, for reasons that seemed to them sufficient, to accept his theories, and the insinuation that they acted the part of the Levite because Gaskell was a physiologist intruding in their territory is as unjust as it is incorrect.

A chapter on the significance of immunization as an example of a direct adaptation contains much that is of interest to biologists in general and this is followed by a chapter

on the inheritance of acquired conditions in the higher animals in which it is claimed that, notwithstanding Weismann to the contrary, there is distinct evidence of the inheritance of such conditions. This evidence is found in Stockard's experiments of breeding from alcoholized guinea-pigs. Here we are confronted by the resurrection of a time-worn discussion, which had its origin, to a large extent, in a failure to understand the meaning attached by Weismann and biologists in general to the terms "congenital" and "acquired." A congenital variation is for them one directly due to a modification of the constitution of the germ cell, while one that was acquired had its origin independently of the germ cell and could be supposed to affect it only secondarily and indefinitely, if at all. Stockard's cases are manifestly examples of a direct intoxication of the germ cells, whereby these were impaired, the impairment being passed on through successive generations, just as changes due to the environment may be transmitted through several generations of bacteria. These cases do not therefore bear on the question of the inheritance of acquired variations, using that expression in the Weismannian sense, but they do show most admirably the cumulative effects resulting from the conjugation in successive generations of vitiated germ cells.

Dr. Adami does not, however, direct all his energies towards the discomfiture of biologists. In the concluding chapters of the lectures he assumes a constructive rôle and outlines a theory of variation and differentiation which is worthy of serious consideration. It assumes as the structural units of the cell the complex protein molecules, each with numerous lightly linked side-chains and capable, therefore, of ready modification under changed conditions. The details of the theory can not be discussed here and those interested must be referred to the lectures and other contributions in which Professor Adami elaborates them, considering in a suggestive manner the phenomena of enzyme and hormone action and of immunity in the light of this chemico-physical hypothesis. The theory can not yet be taken as more than a suggestion, but if it can serve to diagrammatize for us other complicated phenomena as clearly as it has those of fertilization at the hands of Lillie it will become a useful working hypothesis.

The second part of the book consists for the most part of earlier articles and addresses containing the substance of the ideas that have been worked up into the Croonian Lectures, but to these some additional chapters are added, one for instance on the myelins and potential fluid crystalline bodies of the organism, another on the dominance of the nucleus (both reprints of lectures delivered twelve years ago) and another on adaptation and inflammation. The third and concluding section of the volume is entitled "Growth and Overgrowth" and is a collection of addresses and articles dealing with the causation, characteristics and classification of tumors.

J. P. McM.

SPECIAL ARTICLES

STYLONICHIA IMPALED UPON A FUNGAL FILAMENT

The following observations of the curious result of the overzealous feeding activities of a protozoon were made during July, 1918, while the writer was giving the summer session courses in zoology at the State University of New Jersey and Rutgers Scientific School. The material which furnished the organisms here described was obtained from the spray filter bed of a sewage disposal plant near Dunellen, New Jersey. The particular sample of this material in which the organisms were observed had stood over night in a test-tube and, for examination, a small amount was transferred with a pipette from the surface of the fluid in the test-tube to an ordinary microscopic slide. At the first glance through the microscope the material was seen to be swarming with *Stylonichia*, propably *S. vorax* Stokes. Upon moving the slide about, a mass of zoogloeal material was observed and from it some slender branching filaments were projecting into the surrounding fluid.

It was upon these branching filaments that the writer was astonished to see numerous struggling *Stylonichia* impaled, with the filaments passing through their bodies. Not the least astonishing was the fact that many of the animals were located at points basal to branches of the filaments, indicating that they had been held prisoner for some time.

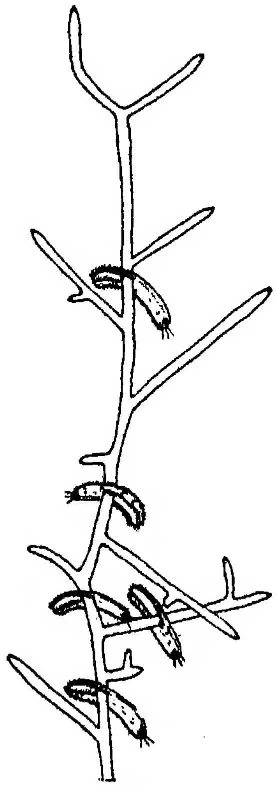


Fig. 1.

The accompanying sketch (Fig. 1), drawn free hand at the time, indicates fairly accurately the conditions on one filament. A number of other filaments were observed to be similarly decorated. From the illustration it will be seen that, beyond the protozoon most proximally placed on the filament, nine branches had arisen and beyond the most distal of the ciliates two branches had formed. Further, it will be observed that the animals invariably had their oral, or ventral, surfaces turned toward the base of the filament and that the filament passed through the oral aperture, or cytostome.

Two ideas are suggested by these conditions; first, that the *Stylonichia* may have become impaled as a result of efforts to swallow the tip of the growing filament, and second that the growth of the filament was comparatively rapid. Subsequent observations confirmed these impressions.

During the two hours following the discovery of the impaled animals some eight or ten individuals were seen to make the attempt to swallow the tip of one or another of the branches of the filaments. *Stylonichia* are known to be energetic feeders and, according to Stokes, this particular species is especially voracious, hence its specific name, *vorax*. In the observed instances the tip of a filament would be taken in until its extremity was near the posterior end of the animal. After a short time spent in the hopeless effort to devour the filament the ciliate would make an attempt to back away and divest itself of the unaccommodating object. In every case of this kind it appeared that the tip of the filament adhered somewhat to the protoplasm of the protozoon, thus interfering greatly with its effort to release itself. There ensued therefore a struggle upon the part of *Stylonichia* which, while possibly not describable as "frantic," nevertheless gave evidence of taxing the powers of the animal to the utmost; and it gave rise to reactions which were decidedly opposed to the success of the object to be attained. To adopt anthropomorphic phraseology one might say that the animal, becoming desperate, seized upon anything at hand in an effort to pull itself away from the now offending "thorn in its flesh." The most convenient and in fact usually the sole object offering such a possible means of escape was the filament itself. Consequently the animal clung to the filament with its strong ventral cirri and endeavored in this way to pull itself away from the tip. The result was to pull itself still further on to the filament and thus to cause the tip to be thrust further into the protoplasm and even—as shown by

the impaled individuals—through the cortex to the outside.

While no animals were observed actually to thrust the filament through their bodies in this way, in several cases they were seen to be pulling with force sufficient to cause a distinct papilla-like elevation on the outer surface and it was easy to see how a slightly stronger pull would have caused the tip to penetrate the cortex, thus impaling the struggling creatures.

In every case of attempted ingestion observed, however, the animals sooner or later abandoned the effort to escape by "climbing" the filament itself; then by turning one way and another, even whirling about the tip at times, they were able eventually to disengage themselves. Had they pulled on the filament while the tip was in the region of the thin cortex at the contractile vacuole, it is probable that penetration would have taken place more readily.

By their efforts to free themselves after becoming impaled the ciliates frequently produced great holes through their bodies much larger than the diameter of the filament. It seemed therefore that they might possibly have escaped by enlarging these holes through constant pushing and pulling until a rupture was produced at one side. None of them were observed to escape in this way although in some only a relatively narrow strip of cortex prevented.

One instance was noted, when the observations began, in which an individual was impaled with its aboral or dorsal side toward the base of the filament. It was near the end of a branch and by pulling on the part of the branch distal to it the animal was soon enabled to reach the end and escape. This exception to the rule can best be accounted for by supposing that the individual was accidentally stabbed through during the transfer to the slide with the pipette. In all the other cases observed, as noted above, the oral sides of the animals were toward the base of the filament.

As to the filament, its fungoid nature was indicated by the entire absence of color. It appeared to be far more rigid than most of the zoogloeal specimens and in fact its rigidity is attested by its effect on the protoplasm of its would-be devourer. The growing tips are seen to be rounded but tapering somewhat at the ends. The tapering and relatively rigid point would possess the necessary piercing powers to produce the results observed.

In addition the filaments grew with surprising rapidity. The one illustrated was about four millimeters long at the time it was drawn but an hour later the two distal branches were more than twice the length from their junction that they were at the time of drawing. The estimated growth during the hour was nearly half a millimeter and, in fact, the increase in length was so rapid as observed under the microscope that one could see the difference from moment to moment. The rapid growth, then accounts for the relatively great length and numerous branches that were found distal to the points where the pierced animals were still struggling.

Perhaps this case may be cited as an example of maladaptation on the part of *Stylonichia vorax*, its feeding instincts having led it to attempt the impossible, namely, to swallow an unswallowable object; and furthermore an object which, by reason of its adhering to the animal's protoplasm, set up in the struggle to free itself reactions which resulted in forcing the rigid point of the object through its body, making it a prisoner.

D. H. Wenrich
University of Pennsylvania

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, DECEMBER 20, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

NATIONAL PRESTIGE IN SCIENTIFIC ACHIEVEMENT[1]

IN our development and application of scientific principles, the intensive factor of publicity is by no means to be ignored. It may be magnanimous to give others full credit for what they have done and to belittle our own achievements, but it is hardly fair to the nation as a whole so long as public opinion continues to be so strongly influenced by publicity. We are familiar with the prestige in pure and applied science enjoyed by Germany prior to the war and many of us are familiar with her methods, some of them entirely legitimate by every standard, others entirely indefensible by any standard. We envied Germany her diligent, productive scientists, smiled at her many false claims to superiority and originality, contributed rather freely to German scientific literature, with some qualms of conscience and pretty generally despised German technologists for their piratical methods. "How do they ever get away with it?" we asked ourselves and let it go at that. It never occurred to many of us to assert our scientific independence as a matter of national duty and Germany was rapidly attaining the leadership she craved. In penance we now burn our German books and studiously avoid reading anything in that language. We are surprised to find how well we can get along without anything in that language and for how little we are really indebted to that nation.

Still it is well worth while to trace out the underlying principles and to apply them to the enhancement of our national welfare. In her

[1] Since this article was prepared (in September) there has appeared in SCIENCE a letter by Professor E. B. Wilson on "Insidious Scientific Control." It appears highly desirable to give this matter immediate and careful consideration to the end that our technical and scientific societies may take effective action in the near future.

good, bad and indifferent activities, Germany attracted a great deal of attention and we are fortunate in having for study a case so well developed and (now) so well understood.

It can not be claimed that scientific ability per capita was higher in native-born Teutons than among other civilized races, yet it is doubtless true that the scientific and technical output was greater in proportion to population in Germany than in any other country and that the prestige she attained in science, technology and in her industries was truly remarkable. In this discrepancy between native ability, achievement and reputation lies the key to the whole problem of securing national prestige in achievement.

More than that of any other nationality perhaps, the Teuton mind had the faculty of intensive application. A specific problem occupies it to the exclusion of almost everything else. While we are prone to work a few hours, then turn to something else or run off to play, the Teuton eats and sleeps with his problem, takes little interest in anything else, talks shop with his colleagues and does not completely relax even in his limited recreation. Our own most eminent scientists, although by no means our most richly endowed, are men who have continued in one line of work year after year and who carry a group of problems with them everywhere.

We Americans are as ready as any to see and to attack difficult and important scientific problems. Nor do we lack the incentive and application necessary to obtain results. What we do lack is the "follow through" to thoroughly search out and master a problem in all its details, generalities and side issues before turning our attention to new problems. To minds teeming with ideas all clamoring for attention, it is not easy to ignore the many that a few may receive fuller attention. However it is obviously necessary to correct this tendency to scattered effort if we are to attain our full measure of national prestige.

The Teutons were further the most prolific writers of scientific and technical literature in recent years. Our libraries were filled with their journals and reference books, and, being available in such profusion, our chemists and physicists constantly consulted them and grew to regard them as authoritative and indispensable. From our own point of view, printing was simply less expensive in Germany, new journals were easily started and books were readily accepted for publication on a narrow margin of profit. Many a struggling scientist eked out a meager salary by compiling and writing reference books when such would not be attempted in this country by men of equal ability. Our publishers require a far greater margin and our experts are too busy to do much writing. Our few good journals are crowded with material for publication months in advance. However distasteful it may be, publish we must if we are to be regarded as leaders.

Alien students, university professors and technical men working in Germany have added greatly in building up her scientific prestige. These aliens in Germany represented fully ten per cent. in each class—clear "velvet" to her and a corresponding loss to their own countries. The alien students came in about equal numbers from Russia, England and the United States with a scattered representation from Scandinavia, Switzerland and Japan but there were hardly any French or other Latins. No special inducements were offered alien students but matriculation was easy while fees and living expenses were very moderate—hardly half those at Cambridge or Oxford. The instruction itself was hardly worth any special effort but it was accessible and it differed from the home product. This country has drawn quite a number of students of engineering and science from Latin America, Japan and China with a few from Russia, Germany and Holland, but with inflexible entrance requirements and moderately high living expenses, alien attendance at our universities has not been large.

German universities drew freely upon foreign countries for their instructors. Their budget system is extremely flexible compared with ours and they drew men freely from Russia,

Holland and Switzerland. It is said that Nernst found Einstein living in a garret in Switzerland and had little difficulty in engaging him for the University of Berlin. It has been estimated that a third of the more noted German scientists were foreign born. Nearly all of these aliens soon become Teutonized and were thereafter regarded as German. No small fraction of the prestige enjoyed by German universities was due to imported talent and to that of the Jews who were treated almost as aliens. The faculties of our universities are undoubtedly too immobile. A freer transfer of instructors from one university to another and from foreign universities to our own will undoubtedly lead to better instruction in them and enhanced prestige for them.

Technical men of ability of all nationalities found in Germany a welcome and a rich field of endeavor. Facilities for working out processes were good and capital for developing manufacturing possibilities not difficult to obtain. A large fraction of the better known German manufactures originated in France, Italy, England or America, the inventor having gone to Germany to secure the opportunity for development not available at home or foreign process having been adopted and developed. We have neither the cheap capital nor the cheap labor in this country but we have the raw material, cheap power and the market, with unequaled opportunities for industrial research in a wide variety of lines of manufacture. What we most need perhaps is a more perfect mobilization of our industrial resources to the end that fewer industrial prospects of value are left unworked. With such we should be able, with improved processes and machinery to compete with cheaper capital or labor anywhere in almost any line of manufacture.

So much for these factors in Germany's scientific and technical prestige more or less worthy of our consideration. There have been many other factors which we need only know to guard against. Plagiarism and piracy were common practises, and from personal knowledge I doubt whether a third of even the more eminent German scientists were free from this taint. Further, work of foreigners was taught as the work of Germans in both literature and science. Neither fairy tale nor scientific discovery, if in an obscure publication, was safe from adoption as their own while the misleading of the young student was easy and common. Our own faults are quite the reverse of these. If anything, in our own work we pay too little regard to the work of others and in our teaching we are rather inclined to magnify the work of foreigners and disparage our own.

In short Germany's scientific and industrial prestige was due chiefly to a better mobilization of forces; freer publication, better opportunities for research, to ideas and talent imported from other countries and plenty of push and pride in achievement. What we need in America is a better mobilization all along the line. We possess plenty of talent, as a rule not well directed nor given much encouragement. We have plenty of universities and industrial research laboratories of the highest grade, operating as uncoordinated individual units with very little team work to achieve large ends. We have many strong scientific and technical organizations each holding regular meetings and supporting one or more journals. These organizations, like our universities, are strongly individualistic and exhibit very little team work or cooperation to achieve broad purposes. Science is only just beginning to be popular in our schools and in the public press; we need to advertise and popularize not only scientific and technical work, but especially deep broad fundamental principles in every line of effort. Finally and most important of all we need vastly increased effort in living up to our possibilities. In habitual effort the Teutons excelled us by at least 30 per cent. and at least equalized their deficiency in originality. We might easily double our stress of achievement without detriment to ourselves.

For some of these problems in securing our prestige and independence through achievement, we have no solutions to offer; for others

the solutions are obvious. Our government has already made a tremendous stride in the promotion of national welfare by drafting our young men and sending them to colleges and universities for their higher mental, physical and moral training. If continued, this policy should yield a plentiful supply of well selected material for our higher scientific, professional, technical and administrative positions, imbued with proper habits and principles.

In the mobilization of our man power already developed, much could be accomplished by our great engineering and scientific societies if but given a freer hand in directing affairs affecting national welfare and in working our broad fundamental problems. They are already providing fairly well for the development and publication of scientific and technical literature and could undoubtedly take care of this and of the writing and publication of reference books. Many very valuable pieces of work have been done by individuals and committees for their organizations which would never have been undertaken by the individual alone. The societies mentioned stand between our great educational institutions and the national welfare which is the objective of higher education and it is very gratifying that they are gaining in influence in both.

The popularizing of organized knowledge and fundamental truths and vital principles of all kinds lies with our individuals of accomplishment and refined judgment. Let these be given every possible encouragement and inducement to pass on their knowledge to those less favored and less advanced.

Finally the increase of our total output all along the line through greater incentives to achievement can only come from the habitual emphasizing of those factors in productive achievement which every individual recognizes in himself. Whenever the question of whether to undertake or not to undertake arises, let us put ourselves under contract to produce certain results. To many of us the strife to increase our income or to secure the praise and respect of others are powerful factors. If we live up to but fifty per cent. of our possibilities we shall at least double our effective output and as a nation, state or individual command the respect of others.

P. G. Nutting

THE CRITERIA IN THE DECLARATION OF CHEMICAL INDEPENDENCE IN THE UNITED STATES[1]

The funds and knowledge and experience of every branch of scientific activity, every ounce of our strength and every grain of our intelligence have been drawn upon in the defense of our firesides and our ideals.

It was a real epoch in the history of chemistry in warfare when the Chemical Warfare Service Section was created as one of the components of our military organization. By its inception the government acknowledged and proclaimed its appreciation of science—entirely too long withheld—for never before has this country realized how indispensable a chemist is in the fabric of our modern economic conditions.

Chemistry is the criterion of a country's very existence. It is the "science of the transformation of matter" underlying all the activities of our complicated social system ever changing, and as well the untold wonders of to-morrow. This fundamental science looks into everything, focuses her light upon everything, directs our paths when the light of nature fails and "allures to brighter worlds" and leads the way. The chemist leads on—harnessing the forces of the universe to his ends, for, in the words of Kipling, "his is the earth and all that is in it." Indeed, for this reason arises the conception that national preeminence in chemical industry means a national world supremacy.

The chemists of America never concerned themselves with the prostitution of science, but called upon to provide our nation with the new diabolic arms of modern scientific warfare developed by a militaristic autocracy, they served ably and completely. Our eminent success is a cause of pride to every American. In

[1] Address delivered at the annual meeting of the Alabama Section of the American Chemical Society in Birmingham, December 7, 1918.

three years American chemical genius has done as much and as well as Germany has during three quarters of a century. This sudden unparalleled achievement will affect our chemical industry for a century. That Monday morning when the last gun was fired we passed into a new age—the beginning of an era of chemical progress, of chemical independence in this country, of research in the unfolding of the secrets of nature to make for a longer, happier life for man, of constructive productiveness for the universal brotherhood of man.

The stimulus of scientific work is enormous and the growth of knowledge astounding. We have thus far reached a position of independence which might not have been attained for decades to come. Let us keep the American chemical flames a-burning, the chemical barometer a-rising. Let American chemical progress tower above all. Let us have a Declaration of Chemical Independence in this country.

Let us now consider the criteria in the development and independence—industrial and scientific—of chemistry in America.

Resultant chemical achievement seems to be the product of four factors—the college and university, the industry, the American Chemical Society, and the government.

THE COLLEGE AND UNIVERSITY IN THIS NEW AGE

The fundamental responsibility rests upon the college and the university—the sources of our chemists. Thorough up-to-date training is the all-important feature. The courses must be standardized and correlated—all welded into one outstanding science. Modern chemistry is getting more and more quantitative. The bonds between mathematics and physics, on the one hand, and chemistry, on the other, have been drawn closer, with the effect that physical chemistry is penetrating every phase of the science, thus widening our outlook and rendering our conceptions more precise. Developing and applying physico-chemical theory and methods, gives us insight into intricate problems and unravels mysteries. Utilizing physico-chemical interpretations in all courses means training in the chemistry of the future. Understanding the "how" of chemical transformation is the only clear path to science, the true, the patient and loving interpretation of the world we live in, the laws governing it and the order and beauty revealed everywhere. Mechanical "rule-of-thumb" mastery of the principles leads one, really crammed with bookwork, to practise what in his case could only be a black art—without inspiration, without orientation. The real achievements of the hour have been brought about by men of thorough training and deep insight into the pure scientific principles. Our institutions therefore should turn out not men who know a lot—assimilators of other peoples' ideas—but research men of creative type of thought.

Modern chemistry developed from the physico-chemical standpoint is radiating in all directions, affecting all sciences and all industries as well as its own branches. It is high time that chemists of the old schools get out of their shells, view and accelerate this growth and application of their science. As we have geological chemistry, photo-chemistry and all the other correlated chemistries with full realization of their service to man, let us stimulate more and more of this correlation not only to the pure but as well to the applied sciences and professions. Indirectly, by way of illustration of the dire need of intensive chemical training in other branches of pursuit—our physician may be put to the test. He prescribes diets and knows little or no food-chemistry. He "interprets" bio-chemical analyses and has little comprehension of physiological chemistry. He deals with the human body—a true colloid—and has not the slightest idea of colloidal chemistry. And so the story goes. Bio-chemical progress is astounding as a result of the application of chemistry to medicine. More of this coordination is needed in teaching, researching and application in every conceivable field. They all involve chemistry.

To give adequate training physical equipment of an institution is an essential efficiency factor. The real contact with the subject is in the laboratory, therefore the necessity for intensive laboratory instruction for the development of technique and systematic scientific observation and deduction.

Apropos, our institutional and industrial laboratories must foster the genuine American spirit of utilizing and encouraging domestic "Made-in-U. S." chemicals and scientific apparatus from precision instruments to filter paper.

A word in regard to a seemingly neglected corps in the service of chemistry—women. Prejudice must be overcome. They have proven to be competent workers. Chemistry is a most fitting field for women. Her natural concentration on matters of minor import, her soundness of judgment, her sense of practical realities are invaluable qualities in a laboratory worker. We must induce more women into the field.

Teachers of chemistry must be gifted with that pedagogic approach and method that will instill and stimulate the scientific spirit. Successful professors of chemistry must profess to be pedagogues as well as chemists. They are indispensable in the successful training of spirited chemists and teachers of chemistry. We must have more chemists of pedagogical training to turn out more successful teachers of chemistry. In preliminary scientific training we must concentrate as much on the methods of teaching, the logical development of the principles from the student's viewpoint, with broad-minded intensification of the far reaching applications of the principles, with greater emphasis on exact scientific expression as on the science itself. Teachers of science must stop scaring beginners away from it because of their hackneyed paraphrased modes of expression far from the student's comprehension. Science is simple clean-cut truth. We practise it daily. Every student can and will understand it if you will appeal to him on his level. Science is a living subject. Let not your language deaden it. Remember that science was not made for language but language for science. Live up to it.

Teachers of chemistry have an equally important task—the man of science is intended for research, all will admit in the light of the modern age; but in whose time and with whose money? A college or university must disseminate knowledge through research as well as through teaching. The double task upon the professor entitles him to be relieved of worry regarding "financial modus vivendi." He is the most important person in the "post-bellum" community in emergencies, in peace and in war. To-day, no fact stands more clearly demonstrated. A soldier and an army can be made in a year, if necessary, but it takes twenty to twenty-five years to make a scientist. His salary should be commensurate with his specialization.

In a word—the great task and responsibility of the college and university to-day is to speed up our intellectual potential.

INDUSTRY IN CHEMICAL ADVANCEMENT

Industry has a most important bearing upon chemical advancement. In the first place, exploitation of chemists must cease. Manufacturers must learn to cooperate with their chemists whose skilled service reaps wealth and welfare to both nation and industry. Productive chemists should benefit from the fruits of their success.

Then, too, greater cooperation should be extended the investigator, the elaborator of the content of the science and its farther coordination. One means is by offering graduate industrial fellowships as in the Mellon Institute at Pittsburgh, where school, laboratory and practise are in harmonious heterogeneity. Another is to have an advisory staff of professors of chemistry in different specialties bearing upon the industry directly or indirectly. A third is to have each industrial corporation establish specialized research laboratories in their own plants or contribute to the organization of central institutes devoted to practical technical problems. A further urgent task upon the manufacturer is to concentrate more on and invest more capital in promoting industries essential for daily needs.

There are innumerable industries whose processes are chemical yet these manufacturers are still delving in "cook-book" procedures, ever groping in the dark. The dawn of the brighter chemistry has not struck them as yet. They are still under the false impression that science is a happy family of mutually admir-

ing absent-minded philanthropists striving for the benefit of the human race. They still fail to see the connection between science and their industry. They are not aware that the whole vista opened out by modern chemistry lays bare hitherto unsuspected depths of complexity in the most insignificant things about us. It is ignorance pure and simple and truly a curse upon the nation's advance.

Another condition that must be remedied—the engineer with little knowledge or training in chemistry in charge of the design, erection and control of chemical plants and processes. Associated with him is a routine "analyst," entirely dependent upon him. Neither have any idea of the mechanism and interpretation of chemical processes involving mechanics, hydraulics, hydrostatics, thermodynamics, thermophysics, thermochemistry, physical chemistry and what not. Our pressing obligation, therefore is to train men more profoundly and thoroughly in the fundamental theories of the science—in mathematical, in physical, in biological as well as in the chemical branches. The industrial world to-day demands this type of broadly-trained man.

The unfounded popular craze and cry of intellectual people is for "applied science," failing to realize that there is no applied science until you have science to apply. Pasteur propounded the wonders in bacteriology by attempting to disprove the doctrine of spontaneous generation. Helmholtz never thought of preventing eye diseases when he introduced the ophthalmoscope. Cavendish never dreamed of the double purpose of his idea of "fixing nitrogen" appearing like Brahma in two aspects—Vishna the Preserver and Siva the Destroyer. The world triumphs are indebted to pure science.

THE AMERICAN CHEMICAL SOCIETY IN THE SERVICE OF PROGRESS

Such being the case, our chemical associations should welcome more papers on theoretical than on "dollar" chemistry—of mutual benefit to all its members—teaching, research and technical chemists.

The American Chemical Society, the great growing body of American chemical genius should organize a central research clearing house to receive problems for research from all conceivable sources in the country—industries, schools, research laboratories. These may be published in the journals for interested members to attack.

Then too, the question of handbooks must be settled. It is useless to continue to discuss the matter. Discussions evolve more heat than light. This is no time for talk but for action. We must have our own handbooks in English. We must stop relying on any one for anything. The time has come for independence in educational and scientific materials in this country. There is no greater body than the American Chemical Society to foster by united action this wholesome spirit of scientific independence.

THE GOVERNMENT'S RÔLE IN OUR CHEMICAL INDEPENDENCE

Another vitally important rôle in the establishment of chemical independence in our country must be played by our government.

To stop depending upon foreign sources of supply, our government should utilize and extend its surveys of national resources; enforce their conservation; transform sleeping villages into great centers for industrial activity; enact wise legislation for protective duties which will aid in the improvement of essential industries for daily needs; encourage the use of "Made-in-U. S." materials; carefully consider patent legislation; establish more official experimental stations for theoretical and industrial research; build central scientific research reference libraries indispensable in research in growing industrial centers; continue through "scientific statesmen" to stimulate and encourage research; and give the chemist, the scientist his entitling share to a highly responsible position in national life and in the councils of those directing our national policies. "To him that hath shall be given."

In the midst of all our great chemical progress, our government should concern itself with a feature of dire import—the standardization of the title "chemist." A bottle-

washer, a laboratory assistant, an "analyst" hanging on to the coat-tails of a chemical engineer, a technician "analyzing" urine from morn to midnight, a drug clerk handling chemicals, a coffee or tea "nose" specialist—all cogs in the chemical wheel are to-day classed as chemists together with the professor of chemistry, research and industrial chemists. The title "chemist" must be standardized. Those who by right of training and occupation deserve this name should urge upon our government to lay down definite standards for the profession and place it in the same plane with medicine or law. An institution's diploma or an association's membership or whatever else may be feasible in the national standardization, should represent the chemist's license. Partial action in this direction has been inaugurated by the Chemical Warfare Service Section in classing men as "analysts" who received sufficient training in chemistry to enable them to carry on routine analyses under direction and as "chemists" who have special training in any of the branches of chemistry. This classification is a step in the right direction. It was for the war program. Now let there be a complete classification for the peace program.

To conclude—chemistry has proven to be America's bulwark of defense. In return, America must recognize all the more the indispensable service of the scholar, the thinker, the investigator of science, in national preservation. May our new democratic age stimulate scientists in their search of truth not only for truth's sake but for humanity's sake in our universal brotherhood of man.

I. Newton Kugelmass

Howard University

CHARLES RICHARD VAN HISE

The following minute has been voted by the board of regents of the University of Wisconsin:

Dr. Charles Richard Van Hise, the president of the University of Wisconsin, departed this life November 19, 1918, after an unbroken connection of forty-four years with the institution, as undergraduate, through all grades of the faculty, and as president for the past fifteen years.

Nearly every living alumnus, every faculty member and executive officer has come into intimate personal contact with him during the long period of his connection with the university, and to know him was to love him, to serve with him a privilege, and to serve under him a benediction.

Recognition of his genius, as a scientist, as an educator, and as an executive, comes to us from every quarter of the nation and civilized world. We would not here catalogue his virtues, his excellences, nor his achievements in his many fields of intellectual and personal activity. We knew him as a friend, co-laborer and associate. The many hours we have spent with him are a priceless asset; his activities and his accomplishments are an inspiration to us and a call to better things. We shall miss him as a friend, counsellor and brother; we shall strive to be better for having known him. We mourn with the family, with the university, with the nation, and with the world over his untimely passing. We deplore our loss, but we know that the world is richer for his having lived and served.

The faculty of the University of Wisconsin has drawn up the following memorial resolution in honor of President Van Hise:

We, the faculty of the university, would pay our tribute of respect and love to our departed leader, President Charles R. Van Hise. His death has afflicted us with the deepest sense of public and personal loss. We rejoice, however, in the service that he rendered to his fellow men. He preached the gospel of service, and he practised it with insight and energy. His service was not the condescension of the great to the humble, but the solicitude of the elder brother for his brethren. To him the great object in life was to release the capacities of men, to help them learn how to help themselves.

His broad conception of the part that the university should have in this work of spiritual liberation was firmly grounded in respect for pure scholarship, and his success in securing its fuller realization is one of his titles to grateful remembrance. He had a democrat's faith in the ability of the people of Wisconsin to recognize the worth of university training. No opposition, no doubts or fears, could shake his confidence in their unfaltering and full support of the university which sought to open to all a door to richer and nobler living.

He was truly a democratic leader. He was

simple in his tastes, delighting in the curling smoke of the campfire and the small, still voices of the wild woods. He was accessible to every one and sought advice from all who would offer it; he respected honest opponents and worked with them as harmoniously after a conflict as before; he endured even malicious personal criticism with serenity. His tolerance was indeed amazing, and it sprang, not from indifference or disdain, but from single-hearted devotion to the larger, benign purposes that he cherished for men, and from the concentration of his strength upon the effort to realize them.

It was characteristic of the steady and consistent broadening of his interests that he passed from the study of the forces which have knit the outer fabric of the earth to the investigation of some of the potent influences which make or mar the welfare of men. The well-being of the people of Wisconsin, of the people of the nation, engaged the productive energies of his mature manhood. When the great war came and threatened the destruction of western civilization, he bent all the powers of his mind and heart to the great problem of gaining the victory for liberty and justice, and then, in these later, stupendous weeks, to a greater problem of making that victory secure through the organization of a brotherhood of free nations. The leader who began his presidency with the noble ideal of freeing human capacity throughout the commonwealth of Wisconsin fittingly crowned his too brief days, in the fulness of his powers, with well-wrought plans for ensuring to national and to individual capacity a free opportunity throughout a liberated world.

We rejoice that he has dwelt among us and that his spirit has moulded and will continue to mould the life of the university. "They may rest from their labors; and their works do follow them."

SCIENTIFIC EVENTS

THE PRODUCTION OF MARBLE IN 1917

The value of marble sold in the United States in 1917, according to reports made by the producers to G. F. Loughlin, United States Geological Survey, Department of the Interior, was $6,330,387, a decrease of 10 per cent. ($702,784) from the value in 1916 and the lowest annual value for our marble output since 1904. The quantity produced in 1917 was about 3,627,750 cubic feet (310,130 tons), as against about 4,795,000 cubic feet (409,970 tons) in 1916—a decrease of 24 per cent. The quantity produced in 1917 included a small proportion of serpentine, as shown in a later paragraph, but no "onyx marble."

Of the marble sold in 1917, 2,156,351 cubic feet (about 184,370 tons), valued at $6,100,280, was building and monumental marble—a decrease of 33 per cent. in quantity and 11 per cent. in value compared with 1916. The average price of this stone per cubic foot was $2.83 in 1917 and $2.13 in 1916.

The marble sold for use as flux, terrazzo and mosaic work, and ornamental stone, and the pulverized marble sold for use in agriculture and in manufactures amounted to 125,764 tons, valued at $230,107. The marble sold for these purposes in 1916 amounted to 136,217 short tons valued at $209,155.

The total value of marble sold in 1917 for use as building stone (3,702,563) was 22 per cent. less than that sold in 1916, and the total quantity (1,470,793 cubic feet) was 35 per cent. less. Exterior building stone, which represented 36 per cent. of the total quantity of building stone, decreased 37 per cent. in quantity and 25 per cent. in value; stone for interior work, which represented 64 per cent. of the total quantity, decreased 34 per cent. in quantity and 20 per cent. in value. Marble sold dressed for use in the exterior of buildings was the only building stone product that showed increase in quantity (13,549 cubic feet) in 1917; but the value of this product decreased $38,328 (4.7 per cent.). The general average price of marble sold as building stone (rough and dressed) in 1917 was $2.52 per cubic foot; the average value of exterior stone was $2.05 and of interior stone $2.77. Vermont and Tennessee produced over 56 per cent. of the quantity of marble quarried for use as building stone, each state reporting over 390,000 cubic feet. Vermont's output was nearly equally divided between exterior and interior stone, whereas 97 per cent. of Tennessee's product was interior building stone. About 37 per cent. of the Vermont and over 50 per cent. of the Tennessee marble was sold as rough stone. Georgia and Missouri were the next largest producers of building marble,

the quantity produced in each state exceeding 100,000 cubic feet.

The value of the marble produced for monumental use in 1917, including rough and dressed stone, increased $318,307 (15 per cent.) over that in 1916. The quantity, however, decreased 255,230 cubic feet (27 per cent.). The average price per cubic foot was $3.50 in 1917, which was $1.29 more than in 1916. There was a large increase in the quantity of dressed monumental stone sold in 1917—107,403 cubic feet (54 per cent.), but a decrease of 362,926 cubic feet (49 per cent.) in the quantity of rough stone. Vermont produced more than 55 per cent. (377,418 cubic feet), and Georgia more than 25 per cent. of the country's output of monumental marble. Missouri, New York and Tennessee rank next in this product.

Marble for ornamental and "other uses" declined in quantity but increased in value in 1917, as it did in 1916. Marble for "other uses" includes rough stone sold to lime burners, to carbonic acid factories, to pulp mills and to blast furnaces; crushed stone for road metal and terrazzo; small cubes for mosaics; and finished stone for electrical apparatus and ornamental purposes. The stone sold for flux to blast furnaces amounted to 21,194 long tons, valued at $24,899, and for terrazzo to 17,551 short tons, valued at $51,218. In 1916 the stone sold for terrazzo was 24,340 short tons, valued at $83,466.

THE BRITISH NATIONAL UNION FOR SCIENTIFIC WORKERS[1]

The first general meeting of the National Union of Scientific Workers was held on October 27, and was attended by representatives of eleven branches with more than five hundred members. The constitution of the union was determined, subject to slight alterations in redrafting the rules. It was agreed upon by the meeting that the objects of the union should include:—(1) To advance the interests of science—pure and applied—as an essential element in the national life; (2) to regulate the conditions of employment of persons with adequate scientific training and knowledge and (3) to secure in the interests of national efficiency that all scientific and technical departments in the public service, and all *industrial posts involving scientific* knowledge, shall be under the direct control of persons having adequate scientific training and knowledge. Special objects deal with obtaining adequate endowment for research and advising, as to the administration of such endowment, setting up an employment bureau and a register of trained scientific workers, and obtaining representation on the Whitley industrial councils. An applicant is qualified for membership if he or she has passed the examination leading to a university degree in science, technology, or mathematics, and is engaged at the time of application on work of a required standard, though certain other qualifications are regarded as equivalent to university degrees and admitted in lieu thereof. A resolution was carried unanimously that a special advisory committee should be appointed to deal with questions arising in connection with the promotion of research. At the close of the meeting the officers for the ensuing year were appointed as follows: *President:* Dr. O. L. Brady (Woolwich). *Secretary:* Mr. H. M. Langton (miscellaneous). *Treasurer:* Mr. T. Smith (National Physical Laboratory). *Executive:* Mr. G. S. Baker, Dr. N. R. Campbell, Dr. C. C. Paterson (N.P.L.), Mr. R. Lobb, Mr. J. W. Whitaker (Woolwich), Dr. H. Jeffreys, Dr. F. Kidd (Cambridge), Dr. C. West (Imperial College), and Dr. A. A. Griffith (Royal Aircraft Establishment). The address of the secretary is Universal Oil Co., Kynochtown, Stanford-le-Hope, Essex.

[1] From *Nature.*

THE DE LAMAR BEQUESTS FOR MEDICAL RESEARCH

The will of Captain Joseph Raphael De Lamar, mine owner and director in many large enterprises, leaves nearly half of his estate, estimated at $20,000,000, to the Harvard University Medical School, Johns Hopkins University and the College of Physicians and Surgeons of Columbia University for medical reseach into the cause of disease and into the principles of correct living. The

bequests to these institutions in equal shares consist of his residuary estate, estimated at about $10,000,000. He gave a trust fund of $10,000,000 to his only child, Alice Antoinette De Lamar, with the provision that if she dies without issue the principal of this fund also goes to the institutions named. The clause setting aside the residuary estate requests that the fund be used as follows:

For the study and teaching of the origin of human disease and the prevention thereof; for the study and teaching of dietetics and of the effect of different food and diets on the human system, and how to conserve health by proper food and diet and in connection with the foregoing purposes to establish and maintain fellowships, instructorships, scholarships and professorships; to construct, maintain and equip laboratories, clinics, dispensaries and other places for such study and research and to provide proper housing of same; to publish and disseminate the results of such study and research, not only in scientific journals and for physicians and scientists, but also, and this I especially enjoin on the legatees, by popular publications, public lectures and other appropriate methods to give to the people of the United States generally the knowledge concerning the prevention of sickness and disease, and also concerning the conservation of health by proper food and diet.

The will suggests that the legatees use any means they deem expedient for the purposes named, and requests that the fund be kept intact.

SCIENTIFIC NOTES AND NEWS

THE Royal Society has awarded its Darwin medal to Professor Henry Fairfield Osborn, president of the American Museum of Natural History, in recognition of his research work in vertebrate morphology and paleontology. The Copley medal goes to Professor H. A. Lorentz, late professor of physics in the University of Leyden, For. Mem. R.S., for his researches in mathematical physics; the Davy medal to Professor F. S. Kipping, F.R.S., professor of chemistry, University College, Nottingham, for his studies in the camphor group and among organic derivatives of nitrogen and silicon; a Royal medal to Professor F. G. Hopkins, F.R.S., professor of bio-chemistry in the University of Cambridge, for his researches in chemical physiology.

SIR J. J. THOMSON was reelected president of the Royal Society at the anniversary meeting on November 30. The other officers are: *Treasurer:* Sir Alfred Kempe. *Secretaries:* Professor Arthur Schuster and Mr. W. B. Hardy. *Foreign Secretary:* Professor W. A. Herdman. *Other Members of the Council:* Sir George B. Beilby, Professor V. H. Blackman, Mr. C. V. Boys, Sir James J. Dobbie, Sir Frank W. Dyson, Dr. M. O. Forster, Professor F. W. Gamble, Dr. J. W. L. Glaisher, Sir Richard Glazebrook, Sir Alfred D. Hall, Sir William Leishman, Professor W. J. Pope, Dr. W. H. R. Rivers, Professor E. H. Starling, Mr. J. Swinburne and Professor W. W. Watts.

THE Swedish Academy has awarded the Nobel prize for physics for the year 1917, to Professor C. G. Barkla, professor of natural philosophy in the University of Edinburgh, for his work on X-rays and secondary rays. The prize in physics for 1918 and that in chemistry for 1917 and 1918 have been reserved.

DR. PIERRE ROUX, director of the Pasteur Institute of Paris for many years, will retire from that post. He will be succeeded by Dr. A. C. Calmette, director of the Pasteur Institute of Lille.

THE Salters' Company has appointed Dr. M. O. Forster, F.R.S., to be the first director of the newly established Salters' Institute of Industrial Chemistry.

DR. GEORGE DAVID STEWART has been elected president of the New York Academy of Medicine.

MR. F. K. BEZZENBERGER, of Harvard University, has been commissioned captain, and is stationed at Cleveland as gas chemist in the Chemical Warfare Service.

DR. ROBERT P. FISCHELIS, director of the control department of the H. K. Mulford Co., has entered the Chemical Warfare Service and has been stationed at the control lab-

oratory of the Gas Defense Plant, Long Island City, N. Y.

Dr. Solon Shedd, head of the department of geology, State College of Washington, has been granted leave of absence for a year to engage in the production of casing head gasoline in the Oklahoma oil fields.

Dr. J. N. Rose, associate curator of the division of plants, U. S. National Museum, has returned from Ecuador where he spent three months' making botanical collections and has brought back a large series of specimens.

At the anniversary meeting of the Mineralogical Society, London, held on November 5, the following officers and members of council were elected:—*President:* Sir William P. Beale, Bart. *Vice-presidents:* Professor H. L. Bowman and Mr. A. Hutchinson. *Treasurer:* Dr. J. W. Evans. *General Secretary:* Dr. G. T. Prior. *Foreign Secretary:* Professor W. W. Watts. *Editor of the Journal:* Mr. L. J. Spencer.

At the annual meeting of the New York Academy of Science on December 16, the address was given by Professor S. A. Mitchell, of Leander McCormick Observatory, University of Virginia, his subject being "Results of the eclipse of 1918."

Mr. Vilhjalmur Stefansson was presented with the gold medal of the American Geographical Society at its monthly meeting on the evening of December 17, in the Engineering Societies building, 29 West 39th Street. Mr. Stefansson delivered an address on "The value of northern exploration."

We learn from *Nature* that the council of the Chemical Society, London, has arranged for three lectures, bearing on the ultimate constitution of matter, to be delivered during the present session. The first lecture, entitled "The conception of the chemical element as enlarged by the study of radio-active change," was delivered by Professor F. Soddy at the ordinary scientific meeting held at Burlington House on December 10.

M. Paul Kestner, the president of the French Society of Chemical Industry, delivered an address on "The Alsace potash deposits and their economic significance in relation to terms of peace," to the London Section of the Society of Chemical Industry on November 4.

On November 20 the opening address of the one hundred and sixty-fifth session of the Royal Society of Arts was delivered by Mr. Alan A. Campbell Swinton, chairman of the council, his subject being "Science and the future."

The death is announced of Dr. Henry Gustav Beyer, U. S. N., retired, who died at his home in Washington, D. C. He was born in Saxony in 1850, and was graduated from the Bellevue Hospital Medical College in 1876. He entered the United States Navy in that year as an assistant surgeon and reached the rank of medical director in 1911, retiring a year later.

Harvey E. Vasey, associate professor of botany in the Colorado Agricultural College, died at Fort Collins, Colorado, on December 10. At the time of his death he was second lieutenant in the Students' Army Training Corps, assigned as personnel adjutant.

Miss Rose M. Taylor, M.S., for ten years instructor in botany at the Michigan Agricultural College, died on December 6, after a short illness as a consequence of influenza.

Vern B. Stewart, Ph.D. (Cornell), succumbed to pneumonia on December 8, aged thirty years. Dr. Stewart held a research position as assistant professor of plant pathology at Cornell University for five years, during which time he made numerous contributions to his science. The most notable of these concern diseases of horticultural and ornamental nursery stock. On July 1 last he became pathological adviser to the eastern market inspectors of the U. S. Department of Agriculture. This work had to do particularly with detecting incipient disease in shipments of perishable plant products intended for the army and navy. Exposure in the performance of this duty led to the fatal attack.

Major Harry Douglas Gill, for thirty years connected with the New York University Veterinary College as member of the teaching staff in surgery, secretary and president,

died at Waynesville, N. C., on October 8 at the age of fifty-seven years. The college announces the establishment of the Major Harry Douglas Gill Scholarship "to give some poor New York boy an opportunity to get four years' training in veterinary surgery and medicine."

PROFESSOR H. E. J. G. DU BOIS, known for his contributions to the knowledge of magnetism, died at Utrecht on October 2.

SIR HENRY THOMPSON, professor of physiology and later of medicine at Dublin, the author of important researches on physiological chemistry and nutrition, was one of the victims of the sinking of the *Leinster* on October 10.

COPIES of *Nature* just received contain obituary notices of five men who attained to distinction in science while engaged primarily in other work and who died at the average age of ninety years. Sir Edward Fry, a distinguished English jurist, who at the same time made valuable contributions to botany, died on October 18, in his ninetieth year; the Rev. A. M. Norman, F.R.S., honorary canon of Durham, and an eminent worker in many fields of natural history, died on October 26, at eighty-seven years of age; Mr. Thomas Codrington, who died on October 21, aged eighty-nine, was a civil engineer, who made important contributions to geology; R. Brudenell Carter, the English ophthalmic surgeon and author of works upon ophthalmic subjects, died on October 23 at the age of ninety years, Sir Herman Weber, the distinguished London physician an authority on climatology, died on November 11, in his ninety-fifth year.

THE directors of the Fenger Memorial Fund have set aside $500 for medical investigation. It is preferred to assist in work of a direct clinical bearing which may be carried out in an established institution, which will furnish the necessary facilities and ordinary supplies free of cost. Applications with full particulars should be sent to L. Hektoen, 637 South Wood Street, Chicago, before January 15, 1919.

THE American Veterinary Medical Association through its president, Dr. V. A. Moore, of Ithaca, N. Y., has appointed committees, one of five from the United States and one of three from Canada to assist in the war departments of the respective countries, and dealing with veterinary reconstruction problems.

THE executive committee of the American Federation of Biological Societies has voted to withdraw the annual meeting scheduled for Baltimore this year. It has been suggested that a meeting be held some time during the spring.

THE annual meeting of the American Association of University Professors will be held at the Johns Hopkins University Club, Baltimore, on Saturday, December 28. The program will be largely devoted to a discussion of college and university education under conditions of reconstruction. Professor John M. Coulter, of the University of Chicago, is president of the association as well as of the American Association for the Advancement of Science. Profesor H. W. Tyler, Massachusetts Institute of Technolgy, is the secretary.

THE Bay Section of the Western Society of Naturalists held a two-day session at Stanford University, November 29 and 30, 1918. The local committee of arrangements included J. R. Slonaker, J. O. Snyder and G. J. Peirce, and an enjoyable and profitable program of scientific papers and social affairs was provided. Those who presented papers were as follows: David Starr Jordan, Miss Alice Eastwood, Ivan C. Hall, W. E. Allen, J. R. Slonaker, A. W. Meyer, Miss Annie May Hurd, J. Grinnell, Barton W. Evermann, C. H. Shattuck, W. W. Cort, E. B. Babcock, J. O. Snyder, E. P. Rankin, R. W. Doane, J. A. Long, G. J. Peirce, E. D. Congdon, Charles V. Taylor, S. D. Townley, Forrest Shreve and D. T. MacDougal.

L'Italia che Scrive for June last contains an article on Italian geographical periodicals by Roberto Almagià, which is abstracted in the *British Geographical Journal*. Of these the *Bollettino della R. Società Geografica*

Italiana is, of course, the most important. *L'Esplorazione Commerciale,* the organ of the "Società Italiana di esplorazioni geografiche e commerciali," and *L'Africa Italiana,* published in Naples by the Società Africana Italiana, have both shown signs of increased activity of late years. They are monthlies and deal respectively with commercial and African geography from the Italian point of view. The *Archivio Bibliografico Coloniale* is a quarterly devoted entirely to the new colony of Tripoli. From the energetic "Istituto Geografico De Agostini" of Novara comes *La Geografia, Rivista di Propaganda Geografica,* ten numbers now being published annually. The purpose of the *Rivista Geografica Italiana* is to stimulate interest in geography, more especially in the geography of Italy. It is the organ of the "Società di Studi Geograpfici e Coloniali," but it is quite independent. It also appears ten times during the year. The *Rivista* owes not a little of its importance to the support of the able professors of geography, notably the Marinellis, father and son, who have done so much to make Florence the leading center of geography in Italy. In Florence also are published Giotto Dainelli's *Memorie Geografiche,* which take the form of long monographs, more especially those dealing with the geography of Italy; the *Rassegna della Letteratura Geografica,* a critical view of geographical literature; and the *Rivista di Geografia didattica,* which is concerned with the educational side of geography. All these are published under the auspices of the *Rivista Geografica Italiana.* The writer goes on to regret the absence of a periodical devoted exclusively to the geography of Italy. The publications of the Italian Alpine Club and the monthly bulletin of the "Touring Club Italiano," however, do something to supply this want.

Nature states that the German Chemical Society has celebrated its jubilee by collecting a fund of two and one half million marks for the more extensive publication of chemical works of reference, such as Beilstein. In a report of the annual general meeting an agreement has been concluded with the Verein deutscher Chemiker with regard to publications. The *Chemisches Zentralblatt* will deal more fully with technical chemistry, and will be available to the members of the latter society at a reduced rate. The *Berichte* will be subdivided, one section dealing with reports of meetings, notices, etc., the other containing the original scientific publications. The annual subscription to the German Chemical Society will become 10 marks, but will then only entitle members to receive the first of the above-named sections. A separate subscription will be required for the scientific section, as was already the case with the *Zentralblatt.*

We learn from *Nature* that in accordance with the decision arrived at at the extraordinary general meeting of the Institute of Chemistry held on April 27, local sections are now being formed in various important centers. The inaugural meeting of the Liverpool and North-Western section of the institute was held on Thursday, September 12. The registrar, who was in attendance by the direction of the council, referred to the objects to be attained by the establishment of local sections. It is anticipated that local sections will be inaugurated during the coming session at Manchester, Birmingham, Edinburgh, Glasgow, Gretna, and probably other centers.

At the request of the Bureau of Standards at Washington, government testing of rubber tires will henceforth be carried on at the labortories of the University of Akron for the Akron district and all factories west of Akron. Tires purchased on specification by the government from various rubber companies will be chemically tested by a staff of men assigned to the laboratories under direction of the Bureau of Standards. The work will be installed and supervised under the direction of Mr. Arnold Smith, an Akron man and formerly a student at the municipal university, now employed at the Bureau of Standards. In all probability a force of at least a dozen chemists will be employed in this work. Entire direction of the work will be assumed by the Bureau of Standards and the University

of Akron will furnish space and to a certain extent equipment.

UNIVERSITY AND EDUCATIONAL NEWS

THE late W. J. Murphy, owner and publisher of the Minneapolis *Tribune*, left a large part of his fortune in trust for the establishment of a school of journalism in the University of Minnesota.

THE endowment fund being raised for the establishment of a University College in Swansea has been augmented by donations of £25,000 from Mr. F. Cory Yeo and £10,000 from Mr. W. T. Farr, retiring directors of the Graigola Merthyr Co., Ltd. More than £100,000 have so far been subscribed.

THE sum of £1,000 has been given to the City of London School by Professor Carlton Lambert for the foundation of a science scholarship.

DR. HERMAN CAREY BUMPUS, president of Tufts College for the past four years, has resigned. Dr. Bumpus had been previously professor of comparative anatomy. at Brown University and director of the American Museum of Natural History.

PRESIDENT EDMUND J. JAMES, of the University of Illinois, has withdrawn his resignation. Some time ago he asked to be permanently relieved of his duties at the university in order that he might devote all his time to war work. With the signing of the armistice he has reconsidered that decision.

DEAN E. C. JOHNSON, for the past seven years dean of the division of extension at Kansas State Agricultural College, has accepted an appointment as dean of the College of Agriculture and director of the Experiment Station at the State College of Washington.

DR. LAWRENCE JOSEPH HENDERSON has been promoted to be professor of biological chemistry at Harvard University.

STEPHEN S. VISHER, Ph.D. (Chicago, '14), has accepted an assistant professorship in geography in the University of Indiana.

MR. HARRY L. COLE, who has been in the Aviation Service while on leave from the State College of Washington, will resume his academic duties on January 15, as instructor in the department of chemistry.

DISCUSSION AND CORRESPONDENCE

SYNTHESIS OF PALEONTOLOGY AND MEDICAL HISTORY

THE study of the ancient evidences of disease, for which the term paleopathology was proposed by Ruffer in 1914 during his studies on the pathology of ancient Egyptian mummies, is a phase of medical history which must depend upon paleontological data for its extension. That pathological lesions, especially those on the bones, retain all of their characteristics after many hundreds of thousands and millions of years has been clearly shown and distinct evidences of disease are known as far back in geological time as the Carboniferous. Evidences of traumatism, fractures with the formation of callosities on the inner surface of the shells of brachiopods have been seen as old as the middle of the Ordovician. Reasoning from the theoretical aspects of paleopathology, on the basis of possible parasitism of early hosts, disease may have originated in the Archeozoic but there is no definite recorded evidence prior to the Pennsylvanian.

The relation of paleontological data to medical history is based on the assumption that the manifestations of disease are the same whether seen on man or in animals, and the infection of a Cambrian crustacean by Protozoa is as much a matter of medical history as the presence of osteophytes on the femur of *Pithecanthropus*, the fractured ulna of the Neanderthal man, or bilharziosis among ancient Egyptians.

Many lesions are so commonly seen among fossil vertebrates especially that paleontologists have not referred to them at all, or merely mentioned them incidentally, forgetting that such evidences are of extreme importance in tracing the origin and antiquity of phenomena which are of such vital importance to humanity to-day.

The importance of paleopathology is that it gives an opportunity of studying evidences of disease over a great period of time, and especially is this true in regard to the data offered by paleontology. That the study of these evidences may aid in the solutions of problems which are at present not solved is evident when we consider that many epidemics which sweep the world, such as the one just past, are doubtless the result of an accumulation of changes over a long period of time. It is well known in medical history how whole populations have been swept away by scourges, which, had the people understood them, could have been avoided, and in the future when we come to understand all of the events of past history we may be better prepared to avoid future conditions of a like nature.

A disadvantage under which the student of paleopathology works is that the results of epidemics are scarcely ever recorded especially in paleontological material. The presence of tsetse flies in the Oligocene of Colorado suggests the possibility of trypanosomiasis among the herds of artiodactyls and perissodactyls of the early Tertiary but it can be considered merely suggestive. The search for such evidences is, however, just begun, and we may in future learn more of the epidemics which, in the past, must have swept through the herds of early animals.

The careful description, illustration and study of ancient cases of fracture, of diseased bones or any evidences of pathology is extremely desirable and will advance the study of paleopathology. Evidences of disease may be detected in the positions assumed by animals at death, the opisthotonos, the pleurothotonos and related phenomena. It is a question open to discussion whether the opisthotonic attitude is a manifestation of disease, but it is as suggestive of neuro-toxic disturbances as may well be. Whether the position assumed by the fossilized skeleton is the same as the animal assumed at death, how much is due to shifting before fossilization, are matters of minor importance to the student of medical history who is chiefly impressed with the fact that a dinosaur preserved in the opisthotonic attitude suggests to him the spasms seen in many recent diseases. The student of medical history is interested in a Mesozoic fracture because it extends his knowledge of traumatism, and if the study of the fracture is complete it adds to his knowledge of general pathology.

The relation of disease to extinction, and other more important relations, may be cleared to some extent by a study of paleontological material. The part disease has played in the evolution of forms, whether retarding, changing, or ending their development also attracts the attention of the student of paleopathology.

Medical history, like all other histories, is based on an accumulation of data from widely different fields, and it is the privilege of paleontologists to add to the great wealth already accumulated, more data as to what happened among the animals with which they are familiar, representing the inhabitants of the earth millions of years ago. The subject is worthy of more careful consideration than has been given it in the past. Paleopathology has attracted scant attention among paleontologists but eminent students such as Cuvier, Soemmering, Goldfuss, Schmerling, Leidy, Williston have found the subject of interest. It remained for the men who had been trained in pathology, men like von Walther, Mayer and Virchow, to show the exact relation of pathological lesions among extinct animals to the general problems of disease which are interesting men to-day.

Roy L. Moodie

University of Illinois,
Chicago

A RECENTLY DISCOVERED ART CAVERN IN FRANCE

Under the auspices of the French Académie des Inscriptions and over the signature of M. Ch. Dauzats, there appeared in *Le Figaro* of September 7 an interesting notice of another remarkable discovery of ancient cave paintings in southern France. A translation of the article follows:

These are the most ancient records of human art, as M. Salomon Reinach was remarking yesterday when congratulating Count Begouen who, with his three sons, has just

discovered the above records while exploring the prehistoric cavern at Montesqui-Avantes in Ariège.

The first finds of Count Begouen and his sons, which we mentioned when brought forth in 1914, before the war, were of great interest to the institute.

Some months later the three brothers departed for the front. What they have done there may be learned from the numerous and splendid citations which we have published. But that which they accomplished for science during their furloughs was not known. Yet it is of consequence that we learn and for that reason their father came yesterday to tell the academy that in June last during one of these furloughs which reunited all three sons at Montesqui-Avantes he continued with them the exploration of the Ariège cave.

This time Count Begouen and his sons discovered on the walls of the subterranean galleries some engravings estimated to be thirty thousand years old, and in such quantity and variety that the extraordinary ensemble of prehistoric art work constitutes a veritable museum.

The animals figured in the cave are considerable in number and include reindeers, bisons, horses, both isolated and in groups; bears, elephants and rhinoceroses. The representations of felines are very rare in prehistoric art; but MM. Begouen have photographed in their cave a genuine lion, executed in bas-relief. They have made out also several birds including swans, ducks, as well as three predatory night fliers.

The human figure is likewise represented in the cave, which in recognition of the sons of Count Begouen has been baptized "the Cave of the Three Brothers." A silhouette is particularly remarkable, almost baffling. It represents a man in motion; a man of powerful body, whose head and shoulders are joined by an enormous neck; a man whose upper and lower limbs and whose hands and feet are perfectly human, but whose vertebral column is prolonged in an exterior appendage resembling that of the anthropoids; a man, at last, *qui marche a quatre pattes!*

The suggestions prompted by the magnificent discovery of MM. Begouen have long held the attention of the academy. MM. Dieulafoy, Salomon Reinach, Edmond Pottier, Langlois, Louis Leger, Bouché-Leclercq are particularly interested.

Several communications have been made on the subject by MM. Homolle and Clermont-Ganneau.

N. C. NELSON

SCIENTIFIC BOOKS

The Destinies of the Stars. By SVANTE ARRHENIUS. G. P. Putnam's Sons. 1918. Pp. xvii + 256, illustrated.

In 1903 Dr. Arrhenius was awarded the Noble Prize for his researches in the field of electro-chemistry. To the study of the development of the celestial universe, he, therefore, brings the mind of a trained chemist; the mind of one who is especially fitted to grapple with the intricate problems of the evolution of the stars and planets from the formless masses of gaseous nebulae.

In "The Destinies of the Stars" this evolution is traced through the spiral nebulæ, the gaseous stars, the sun, the worlds to be, Jupiter and Saturn, the world, to the final destiny of all, the dead planets, Mercury and Mars. In this general theory of growth and decay there is, of course, little that is new, but Dr. Arrhenius treats the matter in a new way and brings out many new points.

The chapter devoted to the planet Mars is especially interesting. In this the so-long popular fantastic ideas of Lowell are scientifically and clearly discussed, and the utter impossibility of any life, such as we have any conception of, existing on Mars is conclusively shown. The inhabitants of this planet, the wonderful system of irrigating canals, the whole fabric of intensely interesting fact and fancy so cleverly woven by Lowell, are shown by the clear, concise reasoning of the chemist to be only "such stuff as dreams are made of."

The book is decidedly interesting and well worth careful reading. It lacks, however, continuity. This is due, undoubtedly, to the

fact that the book was not written as a whole, but is a collection of lectures, delivered at various times and places, on different aspects of the general problem of the evolution of the universe.

CHAS. LANE POOR

Modern Navigation. By FRANK SEYMOUR HASTINGS. D. Appleton & Co. 1918. Pp. xvi + 84, illustrated. With introduction by Rear-Admiral Albert Gleaves, U. S. N.

In "Modern Navigation" the author has rendered a real service to all interested in the safe navigation of the seas. In the last quarter of a century there have been many improvements in the art of finding one's place at sea, and the officers of our Navy have been quick to take all possible advantage of these inventions and improvements. Not so, however, with those responsible for the vessels of the mercantile marine. These vessels have been navigated and are being navigated to-day by methods requiring long and cumbersome calculations, by methods long obsolete in the Navy.

When the necessity of manning the vessels, now being built under the emergency of war, was recognized, the government started schools for the training of many thousands of seamen to rank as mates and masters in the new mercantile marine. The attention of those in charge of this training was early called to these new methods and they were urged to start the future navigators right, to discard all the obsolete methods, and to substitute the simple modern method. This was not done: the training has gone on along the old fashioned and antiquated ideas of a past generation. The time and energy of thousands of bright, aspiring young men are being wasted, and old, worn out methods are being fastened on the next generation, all because the power to grant licenses to masters and mates rests in the hands of a few retired seamen, who have failed to keep abreast of the advances in their profession. For this reason the book of Mr. Hastings is most timely; it may help to bring the great advantages of modern methods before the officers and students of the training schools.

This small book gives a short account of the St. Hilaire method. Very wisely all extraneous matter is eliminated, and the book is confined to the bringing before the merchant officer the advantages of the Navy method. The working of this method is shown by a number of concrete examples, and the book is well illustrated with carefully prepared diagrams. The book, however, lacks a clear explanation of the fundamental principles of a "line of position," and of the real underlying basis of the St. Hilaire method.

It is certainly refreshing to see a book on navigation, which is something more than a mere compilation from treatises of a past generation.

CHAS. LANE POOR

SPECIAL ARTICLES

RHINEODON TYPUS, THE WHALE SHARK—FURTHER NOTES ON ITS HABITS AND DISTRIBUTION

IN a brief note published in SCIENCE in 1913[1] I recorded the second taking in Florida waters of this great fish. As an interesting coincidence it may be pointed out that this specimen is the second ever taken in the Atlantic Ocean, or, so far as records go, ever seen therein. In a later and more extensive paper,[2] I gave the details of the capture of this fish with as full a description and as many photographs as possible, and followed these with the natural history of the fish as contained in the writings of those scientists who have been privileged to study it at first hand. Reproduced in this larger paper were all the known figures of this great shark. Inasmuch as in the course of this work there were brought to light a number of accounts and descriptions of this greatest of all sharks which up to that time had remained unknown, it was believed that the paper contained a

[1] Gudger, E. W., "A Second Capture of the Whale Shark, *Rhineodon typus*, in Florida Waters," SCIENCE, 1913, N. S., Vol. 38, p. 270.

[2] "Natural History of the Whale Shark, *Rhineodon typus* Smith," *Zoologica: Scientific Contributions, New York Zoological Society*, 1915, Vol. I., pp. 349–389, 14 figs.

résumé of all the known accounts of the fish. However, during the summer of 1917, while at work on the Bibliography of Fishes in the department of ichthyology of the American Museum of Natural History in New York City, I found a few hitherto unknown references to the whale shark. Since these are of themselves interesting and since they extend our knowledge of its recorded habitat, it seems worth while to collect and publish them as a postscript to the paper referred to above.

Lest any one, seeing the title only, should be misled by it, it may be well to say by way of introduction to our subject, that in the Report of the British Association for the Advancement of Science (Liverpool Meeting, 1870), 1871, page 171, occurs the title "On *Rhinodon typicus*, a Rare Shark lately Added to the Free Museum, Liverpool." However, no data whatever are given.

Furthermore, Lütken's[3] paper, "Om Haplægten Rhinodon" (1874), consists of but a few remarks by this distinguished ichthyologist on the similarity of the gill apparatus of *Rhinodon* to that of the great basking shark, *Selache maxima*. Further than this mere statement, the paper in question does not concern us.

Taking our references chronologically, the next one is very interesting. Julian Thomas (1887) while at anchor in Red Scar Bay, on the south side of New Guinea says that:[4]

A school of sharks twenty-five to forty feet long now surrounded us. . . . The fish came right underneath the bows, and then quietly floated astern on top of the water. We could have touched him with our hands by leaning over the bulwarks. . . . This was a shark—an enormous mottled brute, which seemed as long as our ship. He turned partly over and showed his frightful jaws, which would have taken in a man whole. He was by the computation of the captain and all hands, at least forty feet long, with a six-foot "beam." . . . The sharks were all around, not one of them apparently under twenty-five or thirty feet long. The "boomer" appeared to lead them, and they swam around us both to port and starboard. It almost seemed as if they meant to attack the ship.

This great fish was impervious to bullets, for when fired at with rifles, "The bullets ricochetted off the brute's back" and "shot after shot was fired without much apparent effect." Thomas calls this shark *Selache maxima*, probably because that was the largest shark known to him, but there is no reason to doubt its being *Rhineodon typus*, the giant of all the sharks. His reference to the color and great size effectually settles that.

Those who read my larger article will recall that Captain Steuart[5] says that around the coasts of Ceylon the spotted shark was always surrounded by smaller sharks of which it was the leader. Also Thomas's ricochetting bullets recall what Mr. Brooks wrote me as to the impermeability of the hide of the second Florida specimen to rifle balls.

Of somewhat doubtful value is the following brief account found in a work compiled and edited by Paul Fountain from the notes of Thomas Ward[6] of Australia (1907). It is of doubtful value because, although the fish passed in full view at a distance of eighty yards, no mention is made of the yellow spots and vertical bars which ornament it. These may have been indistinct, or the fish may have been in line with the sun, or it may have been a specimen of *Selache maxima*, to the presence of which in antipodal waters as recorded by the Australian ichthyologists the present writer has recently called attention.[7] Be the explanation what it may, the incident is given for what it is worth.

Fountain had been cruising near the head of the Great Australian Bight, when he fell

[3] Lütken, C. F., "Om Haplægten Rhinodon," *Videnskabelige Meddelelser Naturhistoriske Forening*, Kjøbenhavn aarene 1873, 1874, p. 2.

[4] Thomas, Julian, "Cannibals and Convicts: Notes of Personal Experiences in the Western Pacific," London, 1887, p. 380.

[5] Steuart, James, "Notes on Ceylon, etc.," London, 1862, p. 156.

[6] Ward, Thomas, Paul Fountain, editor, "Rambles of an Australian Naturalist," 1907, pp. 119–120.

[7] Gudger, E. W., "On the Occurrence in the Southern Hemisphere of the Basking or Bone Shark, *Cetorhinus maximus*," SCIENCE, 1915, N. S., Vol. 42, pp. 653–656.

in with a school of sixty-feet sperm whales. His words are:

Before the last of them was out of sight, an enormous shark passed so close to us that we had a full view of it. Like the whales, which it appeared to be following, it swam slowly, passing the *Swan* at a distance of 80 yards. I can therefore testify that its length was at least 40 feet; and in bulk it seemed to be nearly equal to some of the whales. From the circumstances of its great size there can be no doubt that this was a specimen of *Rhinodon typicus*, or the great Pacific basking shark.

Another even more indefinite reference deserves brief mention only here. George Bennett, in 1831 saw two large sharks which he described as follows:[8]

On the 18th of March, 1831, during my former voyage, in latitude 44° 55′ north, and long. 25° 10′ west; in the evening, two sharks of a very large size were seen at a short distance from the ship. A high dorsal fin, projecting from the water, was at first only discernible, and had a resemblance to a rock. It was at first stationary, but soon began to move steadily along, and then occasionally the tail could be seen partially above the water. I know not to what species to refer it; one of the crew on board, who had been in a whaler, said that it was what they named a "bone shark," which is seen in numbers alongside the ships when they are cutting up a whale. He said, also, that he had seen them as large as a *twenty-barrel whale;* that "the mouth resembled the gills of a fish, and they are spotted over the back." Whether the latter part of this account accorded with the actual appearance of the fish, I was not sufficiently near to ascertain, but it appeared correct with respect to its large size.[8]

This fish was seen in the North Atlantic near the Azores, but it is not clear that it was *Rhineodon.* However, the account seems of sufficient interest to warrant its inclusion here. If this fish was the whale shark, then we must note three occurrences in the Atlantic, this being the first.

One of the common haunts of this greatest of fishes is around the island of Ceylon, but it is not unknown in the Bay of Bengal, where it has been recorded by Lloyd[9] in 1908. However, this is not its first record for these waters, for in the year 1835 one W. Foley[10] had given the following vivid account of his experiences. We will let him tell his story in his own words.

On my voyage to Madras (in May last), I saw a most extraordinary fish, and one which had never before been seen by any seaman on board, although some of the officers and crew had been employed in the whale fishery. It was of the size of a whale but differing from that animal in shape; spotted like a leopard in very beautiful manner; it came close under the stern of the ship, during a calm, and we had a magnificent opportunity for viewing it; it had a very large dorsal fin, which it moved about with great rapidity when made angry in consequence of the large stones which we threw down upon it rashly, for it possessed sufficient strength to have broken the rudder and stove in the stern of the ship. Several large fish (seemingly Dog-fish), about a cubit in length and upwards, were gambolling about the monster, entering its mouth at pleasure and returning to the water again. The following will give you some idea of its shape. The mouth very large, dorsal fin black or dark brown, tail also; body covered with brown spots like a leopard, head lizard-shape.

This description leaves no doubt that this was a *Rhineodon,* and to one acquainted with their habits it is equally plain that the "dog-fish" were remoras or echeneises. Chierchia[11] (1884) found several remoras in the mouth of his specimen taken in the Bay of Panama. Others have noted the same fact. Foley's mistake is, however, perfectly excusable. Numerous other writers on sharks and remoras have mistaken these later for young sharks. The present writer was inclined to scoff at such errors, until in the clear waters around Key West, he made a similar mistake in the summer of 1913.

8 Bennett, George, "Wanderings in New South Wales, Batavia, Pedir Coast, Singapore and China," London, 1834, Vol. II., p. 267.

9 Lloyd, R. E., "The Occurrence of *Rhinodon typicus* at the Head of the Bay of Bengal," Records Indian Museum, 1908, Vol. II., p. 306.

10 Foley, W., "An Unusual Sea Monster in the Bay [of Bengal]," *Journal Asiatic Society of Bengal,* 1835, Vol. 4, pp. 62–63.

11 Chierchia, G., "The Voyage of the *Vettor Pisani,*" *Nature,* 1884, Vol. 30, p. 365.

In 1901, Kishinouye of the Imperial Fisheries Bureau, Tokyo, Japan, published an interesting description with a crude figure of a *Rhineodon* taken in Japan which he thought to be a new species and which he named *pentalineatus*. Apparently this paper was reproduced in Japanese as follows: "On Yasurizame (*Rhinodon pentalineatus*)," etc., *Dobuts. Zasshi*, Tokyo, 1903, Vol. 15, 41–44. This journal I have not been able to locate in America, and my letters to Mr. Kishinouye have seemingly gone astray, but the conjecture expressed above seems reasonable.

Our next and last reference is to the occurrence of this fish in the Philippines, where however, it is not entirely unknown since Dr. H. M. Smith,[12] the present U. S. Commissioner of Fisheries, has put on record (1911) an 18-foot specimen taken at Negros Occidental in 1910. Again Dr. David Starr Jordan[13] in 1915 recorded the capture of a 20-foot specimen at the island of Zebu in March of that year. However this last reference in question dates back to 1835 when one Captain H. Piddington published in the *Journal of the Asiatic Society of Bengal* a "Notice of an Extraordinary Fish." His account is so circumstantial and so fascinatingly interesting that it seems best to quote him verbatim.

In December, 1816, I commanded a small Spanish brig, and was lying at anchor in the Bay of Mariveles, at the entrance of the Bay of Manilla. One day, about noon, hearing a confusion upon deck, I ran up, and looking over the side, thought, from what I saw, that the vessel had parted [her chain] and was drifting over a bank of white sand and coral, *with large black spots.* I called out to let go another anchor, but my people, Manilla men, all said, "No Sir; it's only the *chacon!*" and upon running up the rigging, I saw indeed that I had mistaken the motion of the spotted back of an enormous fish passing under the vessel, for the vessel itself driving over a bank! My boatswain (*contramestre*), a Cadiz man, with great foolhardiness jumped into the boat with four men, and actually succeeded in harpooning the fish with the common dolphin-harpoon, or grains, as they are usually called, to which he made fast the deep-sea line; but they were towed at such a fearful rate out to sea, that they were glad to cut from it immediately.

From the view I had of the fish, and the time it took to pass slowly under the vessel, I should suppose it not less than 70 or 80 feet in length. Its breadth was very great in proportion, perhaps not less than 30 feet. The back was so spotted, that, had it been at rest, it must have been taken for a coral shoal, the appearance of which is familiar to seamen. I did not distinguish the head or fins well, from being rather short-sighted, and there being some confusion on board.

As my people seemed to look upon "the *chacon,*" as they called it, almost in the light of an old acquaintance, which it was to many of them who had served in the Spanish gun-boat service, I made many inquiries of them, of which the following is the result.

"1. That there were formerly two of these monsters, and that they lived (*teniam su casa*) in a cluster of rocks, called Los Puercos, at the southwest entrance of the bay of Mariveles; but that, about ten or fifteen years before this time, or say in 1800, one was driven on shore, and died close to the village in the bay; the inhabitants of which were compelled by the stink to abandon their houses for a time.

"2. That the remaining one frequented the bay of Mariveles and that of Manilla, and it was supposed that it often attacked and destroyed small fishing boats, which, never appeared after going out to fish, though no bad weather had occurred. This last account I afterwards found singularly corroborated.

"3. That it was considered as dangerous by the Spanish gunboats; that they always when there kept a swivel loaded, the report of which, they said, drove it away. My principal informant was a man, employed as pilot for the ports in the Philippine Islands, whither I was bound, who had passed his whole life in the gun-boats. He said that one instance of its voracity occurred when he was present. A man, who was pushed overboard in the hurry to look at the monster, being instantly swallowed by it.

"4. The native fishermen of the Bay of Manilla quite corroborate this account, and speak of the monster with great terror."

About 1820 or 1821, an American ship's boat,

[12] Smith, H. M., "Note on the Occurrence of the Whale Shark, *Rhinodon typicus*, in the Philippine Islands," *Proceedings Biological Society of Washington*, 1911, Vol. 24, p. 97.

[13] Jordan, David Starr, SCIENCE, 1915, March 26, p. 463.

with an officer and a few men, was proceeding from Manilla to Cavite; but meeting with a severe squall and thick weather, they were driven nearly into the middle of the bay. They were pulling in what they thought the best direction, when on a sudden the sailors all dropped their oars. But the mate, who was steering, looking astern of the boat, saw the open jaws of a huge fish almost over him. Having nothing at hand, he threw the boat's tiller into the mouth of the fish, shouting as loud as possible; when, the jaws closing with a tremendous crash, the whole fish, which they described to be more like a *spotted* whale than anything else, dived beneath the boat, and was seen no more. I do not now recollect the names of the ship, or of the captain, but I thought the circumstance of the spotted appearance a remarkable proof that the story is not an invention. "We do not like to tell it," said the American captain, "for fear of being laughed at; but my officer is quite trustworthy, and we have learned from the fishermen too, that there is some strange species of large fish highly dangerous to their boats."

Like the American officer, I fear almost being laughed at, were it not that, could we collect more facts relative to these strange monsters, they might perhaps at least explain some of the "coral spots" so often mentioned in our charts: independent of its being a matter of great interest to the naturalist. I therefore add here a vague notice of monstrous spotted fish, which are known to the Moluccas.

These are called by the fishermen of Ternate, Celebes, etc., a "*Ikon Bintang*" (or star-fish) from the bright light which they occasion, and by which they are recognized at great depths at night, in calm weather. The Malay fishermen describe them too as spotted, as large as a whale and highly destructive to nets; which they instantly take up when they see the fish, if they can get time to do so; for it is known to destroy boats, and whole lines of nets and fishing stakes, if it once became entangled amongst them, to the ruin of the poor fishermen. I had the same account corroborated in the Sooloo Islands, both by the Malay and Chinese fishermen; as also at Zebu, in the Philippine Islands. At *Sooloo*, I was shown large quantities of the skin of a spotted fish, cut into pieces and dried, for sale to the Chinese Junks, which my people said was the skin of young "*chacons*"—"*Piro no son estos como chacon de alla, Senor.*" "But these are not like our chacon yonder, Sir," was always added. This skin I should have called that of a spotted shark [of the ordinary kind like the tiger shark]; the tubercles were excessively coarse and rough.

It seems thus certain, that some immense *spotted* fish, of highly destructive tendencies . . . exists in the Seas of the Eastern Archipelago.[14]

One hardly knows what to make of this. Andrew Smith (1829 and 1849),[15] the first discoverer of the fish, says "Oesophagus rather narrow," while all the writers about *Rhineodon* who have known the fish at first hand—notably Wright[16] whose opportunities for study of it were greater than all others—have commented on its mild disposition. On the other hand Dr. Jordan (1915) records that the Zamboanga, Philippine Islands, specimen had in its stomach a number of shoes, leggings, leather belts, etc. The structure of its gills, however, plainly shows that it is a whale not merely in size but in manner of feeding. Hence these stomach contents are, as Dr. Jordan notes, incongruous and inexplicable in the light of its gill structures and small oesophagus.

The latter part of Piddington's account is no less valuable than the first since it ties in well with other accounts of the occurrence of *Rhineodon* in the waters of the East Indies, particular in the Celebes. Thus Weber (1902, 1913)[17] states that he saw several in the strait between Buton and Muna in this archipelago. While in the Java Sea, van Kampen (1908)[18] dissected one at Batavia and later obtained a

[14] Piddington, H., "Notice of an Extraordinary Fish," *Journal Asiatic Society of Bengal*, 1835, Vol. 4, pp. 218–222.

[15] Smith, Andrew, "Contributions to the Natural History of South Africa," *Zoological Journal*, 1829, No. 16, p. 643. (*Do.*) Pisces, in Illustrations of the Zoology of South Africa, plate 26 and description, London, 1849.

[16] Wright, E. P., "Six Months at the Seychelles," *Spicilegia Biologica*, Pt. I., pp. 64–65. Dublin.

[17] Weber, Max, "Siboga-Expeditie," Vol. I., Introduction et Description de l'Expedition, p. 88. Leiden, 1902; Vol. 57, "Die Fische der Siboga-Expedition," p. 584. Leiden, 1913.

[18] Van Kampen, P. N., "Die Nahrung von *Rhinodon typicus* Smith," (In Kurze notizen

photograph of still another which was taken on the north coast of Java. Pertinent here are the words with which I closed the section entitled "Habitat" in my larger paper previously referred to: "its special habitat seems to be in the Indian Ocean and the waters contiguous thereto."

E. W. GUDGER

über Fische das Java-Meéres), *Natuurkundig Tijdschrift voor Nederlandsch Indie*, 1908, deel 67, p. 194.

THE BALTIMORE MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE American Association for the Advancement of Science and the national scientific societies named below will meet in Baltimore, during convocation week, beginning on Thursday, December 26, 1918:

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—President, Professor John M. Coulter, University of Chicago; retiring president, Professor Theodore W. Richards, Harvard University; permanent secretary, Dr. L. O. Howard, Smithsonian Institution, Washington, D. C.; general secretary, O. E. Jennings, Carnegie Museum, Pittsburgh, Pa.

Section A—Mathematics and Astronomy.—Vice-president, Professor George D. Birkhoff, Harvard University; secretary, F. R. Moulton, University of Chicago, Chicago, Ill.

Section B—Physics.—Vice-president, Professor Gordon F. Hull, Dartmouth College; secretary, Professor George W. Stewart, University of Iowa, Iowa City, Ia.

Section C—Chemistry.—Vice-president, Professor Alexander Smith, Columbia University; secretary, Professor Arthur A. Blanchard, Massachusetts Institute of Technology, Cambridge, Mass.

Section D—Mechanical Science and Engineering.—Vice-president, Professor Ira N. Hollis, Worcester Polytechnic Institute; secretary, Professor F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

Section E—Geology and Geography.—Vice-president, Dr. David White, U. S. Geological Survey; secretary, Rollin T. Chamberlin, University of Chicago, Chicago, Ill.

Section F—Zoology.—Vice-president, Professor William Patten, Dartmouth College; secretary, Professor W. C. Allee, Lake Forest College, Lake Forest, Ill.

Section G—Botany.—Vice-president, Dr. A. F. Blakeslee, Cold Spring Harbor, N. Y.; secretary, Dr. Mel T. Cook, Agricultural Experiment Station, New Brunswick, N. J.

Section H—Anthropology and Psychology.—Vice-president, Aleš Hrdlička, U. S. National Museum; secretary, Lieutenant Colonel E. K. Strong, Jr., Room 528 State, War and Navy Building, Washington, D. C.

Section I—Social and Economic Science.—Vice-president, John Barrett, Pan-American Union; secretary, Seymour C. Loomis, 69 Church Street, New Haven, Conn.

Section K—Physiology and Experimental Medicine.—Vice-president, Professor Frederic S. Lee, Columbia University; secretary, Professor J. A. Goldfarb, College of the City of New York, New York City.

Section L—Education.—Vice-president, Dr. Stuart A. Courtis, Detroit Department of Educational Research; secretary, Major Bird T. Baldwin, Walter Reed General Hospital, Washington, D. C.

Section M—Agriculture.—Vice-president, Professor Henry P. Armsby, State College, Pa.; secretary, Dr. E. W. Allen, U. S. Department of Agriculture, Washington, D. C.

AMERICAN FEDERATION OF TEACHERS OF THE MATHEMATICAL AND THE NATURAL SCIENCES.—Will hold Council meeting at 10 A.M., December 27. Secretary, William A. Hedrick, Central High School, Washington, D. C.

AMERICAN PHYSICAL SOCIETY.—Will hold joint sessions with Section B, A. A. A. S., from December 26 to 28. President, H. A. Bumstead; secretary; Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

OPTICAL SOCIETY OF AMERICA.—Will meet on Friday, December 27. President, F. E. Wright; secretary, P. G. Nutting, Westinghouse Research Laboratory, East Pittsburgh, Pa.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION.—December 26–28. President, John F. Hayford; secretary, F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

GEOLOGICAL SOCIETY OF AMERICA.—December 27 and 28. Joint meeting with Association of American Geographers, afternoon of December 28; joint meeting with Section E, A. A. A. S., on night of December 28. President, Whitman Cross, U. S. Geological Survey; secretary, E. O. Hovey, American Museum of Natural History, New York, N. Y.

Association of American Geographers.—December 27 and 28. Joint meeting with Geological Society of America on afternoon of December 28. President, Nevin M. Fenneman, New York City; secretary, O. L. Fassig (absent).

Paleontological Society of America.—December 28. President, F. H. Knowlton, U. S. National Museum; secretary, R. S. Bassler, U. S. National Museum, Washington, D. C.

American Society of Naturalists.—December 28. Annual dinner, Saturday night. Vice-president, Guy N. Collins (in the chair); secretary, Bradley M. Davis, Statistical Division, U. S. Food Administration, Washington, D. C.

American Society of Zoologists.—December 26 to 28. Joint session with American Society of Naturalists Saturday morning, December 28. President, George Lefevre, University of Missouri; acting secretary, W. C. Allee, Lake Forest College, Lake Forest, Ill.

American Association of Economic Entomologists.—December 26 and 27. President, E. D. Ball; secretary, Albert F. Burgess, Gipsy Moth Laboratory, Melrose Highlands, Mass.

Botanical Society of America.—December 26 to 28. Joint session with Section G, A. A. A. S., and American Phytopathological Society on Thursday afternoon, December 26. Joint sessions with American Phytopathological Society on Friday and Saturday, December 27 and 28. Joint session with Ecological Society of America on Saturday morning, December 28. President, William Trelease, University of Illinois; secretary, J. R. Schramm, Cornell University, Ithaca, N. Y.

American Phytopathological Society.—December 23 to 28. Joint meetings with Botanical Society of America on Friday and Saturday, December 27 and 28. Tenth anniversary dinner, 6.30 P.M., Wednesday, December 25. President, E. M. Freeman; secretary, C. L. Shear, U. S. Department of Agriculture, Washington, D. C.

Ecological Society of America.—December 26 to 28. Joint session with American Society of Zoologists, Friday morning, December 27. Joint session with Botanical Society of America on Saturday morning, December 28. President, Henry C. Cowles, University of Chicago; secretary, Forrest Shreve, Desert Laboratory, Tucson, Arizona.

American Anthropological Association.—December 26 to 28. Joint session with Section H, A. A. A. S., on December 26, and joint session with American Folk-Lore Society on December 27. President, A. L. Kroeber, Affiliated Medical Colleges, San Francisco; acting secretary, Bruce W. Merwin, University of Pennsylvania Museum, Philadelphia, Pa.

American Psychological Association.—December 27 and 28. Will hold joint sessions with Sections H and L. Secretary, Herbert S. Langfeld, Harvard University, Cambridge, Mass.

American Folk-Lore Society.—December 27. Will hold joint session with American Anthropological Association. President, C. Marius Barbeau; secretary, Charles Peabody, Harvard University, Cambridge, Mass.

American Metric Association.—December 27 to 28. The session of Saturday will be held at the Bureau of Standards, Washington. President, George F. Kunz; secretary, Howard Richards, Jr., 156 Fifth Avenue, New York, N. Y.

Society of American Bacteriologists.—Will meet on Friday and Saturday, December 27 and 28. President, R. C. Buchanan, University of Wisconsin; secretary, A. Parker Hitchens, Army Medical School, 462 Louisiana Avenue, Washington, D. C.

American Society for Horticultural Science.—December 27 and 28. President, C. A. McCue; secretary, C. P. Close, College Park, Md.

Society of American Foresters.—December 27 and 28. President, Filibert Roth, U. S. Department of Agriculture; secretary, E. R. Hodson, U. S. Forest Service, Washington, D. C.

School Garden Association of America.—December 23 and 24. President, J. H. Francis; vice-president and acting secretary, V. E. Kilpatrick, 124 W. 30th Street, New York, N. Y.

American Association of University Professors.—December 28. President, Professor John M. Coulter, University of Chicago; secretary, Dr. H. W. Tyler, Massachusetts Institute of Technology, Boston, Mass.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter

SCIENCE

FRIDAY, DECEMBER 27, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

SCIENCE AND MEDICAL TEACHING[1]

PRESIDENT ELIOT, through the long years of his distinguished service, has begged for a larger cultivation of the sciences among our people and only recently he has demanded that such a wider tuition be introduced into our schools as a necessity of proper national reconstruction. The value of science to mankind is being everywhere more fully appreciated. It is of its prophets in the past that this paper is to deal.

In the preface to the fourth edition of Lavoisier's "Elements of Chemistry," as translated from the original French and printed in Philadelphia in 1799, one finds the following conception of the scientific method.

When we begin the study of any science, we are in a situation, respecting that science, similar to children; and the course by which we have to advance is precisely the same which Nature follows in the formation of their ideas. In a child, the idea is merely an effect produced by a sensation; and, in the same manner, in commencing the study of a physical science, we ought to form no idea but what is a necessary consequence, and immediate effect, of an experiment or observation. Besides, he who enters upon the career of science, is in a less advantageous situation than a child who is acquiring his first ideas. To the child, Nature gives various means of rectifying any mistakes he may commit respecting the salutary or hurtful qualities of the objects which surround him. On every occasion his judgments are corrected by experience; want and pain are the necessary consequences arising from false judgment; gratification and pleasure are produced by judging aright. Under such masters, we can not fail to become well informed; and we soon learn to reason justly, when want and pain are the necessary consequences of a contrary conduct.

In the study and practise of the sciences it is entirely different; the false judgments we may

[1] Address at the meeting for the award of honors to students of medicine of Harvard University, December 16, 1918.

form neither affect our existence nor our welfare; and we are not compelled by any physical necessity to correct them. Imagination, on the contrary, which is ever wandering beyond the bounds of truth, joined to self-love and that self-confidence we are so apt to indulge, prompt us to draw conclusions which are not immediately derived from facts; so that we become in some measure interested in deceiving ourselves. Hence it is by no means surprising, that, in the science of physics in general, men have so often formed suppositions, instead of drawing conclusions. These suppositions, handed down from one age to another, acquire additional weight from the authorities by which they are supported, till at last they are received, even by men of genius, as fundamental truths.

The only method of preventing such errors from taking place, and of correcting them when formed, is to restrain and simplify our reasoning as much as possible. This depends entirely on ourselves, and the neglect of it is the only source of our mistakes. We must trust to nothing but facts: These are presented to us by Nature, and can not deceive. We ought, in every instance, to submit our reasoning to the test of experiment, and never to search for truth, but by the natural road of experiment and observation.

Thoroughly convinced of these truths, I have imposed upon myself, as a law, never to advance but from what is known to what is unknown; never to form any conclusion which is not an immediate consequence necessarily flowing from observation and experiment.

Such, then, were the principles of this great master scientist of France as he wrote them a hundred and twenty-five years ago. And yet they seem vibrant with the teachings of our own day and generation. Perhaps it may be of interest to examine the growth of this modern mental attitude, especially in its relation to medicine.

The universities of Cambridge (founded in 1229) and Oxford (founded in 1249) were established at a time when authority was worshipped. It was not until after the revival of learning in Italy that the original versions of the ancient classics of Greece and Rome were brought to these English universities, there to be studied at first hand and the unknown culture of a bygone civilization revealed. In this way it was learned, for example, that Hippocrates (circa B.C. 480) had been misquoted by Galen, for the Father of Medicine in truth had remarked:

Whoever having undertaken to speak and write on medicine have first laid down for themselves some hypothesis to their argument such as hot or cold or moist or dry or whatever else they choose (thus reducing their subject within a narrow compass and supposing only one or two original causes of disease or of death among mankind) are clearly mistaken in much that they say.

This was a far more liberal doctrine than the interpretation of Galen († A.D. 200) who, in his medical definitions, says: "The elements of medicine, as some of the ancients thought, are hot and cold, moist and dry" and "Of what do our material bodies consist? Of the four elements, fire, air, earth and water."

So from this ancient fount of information Chaucer's doctor knew the causes of diseases:

He knew the cause of every malady
  Were it of cold or hot or moist or dry
And where engendered and of what humour,
  He was a very perfect practisour.

It is evident that the revival of learning in the fifteenth and sixteenth centuries, with its scholarly search through the buried classics, must have had a profound influence upon men's minds in its revelation of the forgotten past. That the elements of Empedocles, fire, air, earth and water, should have been the accepted basis of the chemical world for nearly two thousand years seems incredible to the modern mind. And yet, when one considers the past, one is forced to the conviction that the general adoption of revolutionary principles, as lately carried out in Russia, might once again reduce the world to the condition in which it existed during the Dark Ages. And one might conceive that a European or an American a hundred years hence might have to travel to Tokio in order to find a copy of the *Journal of Biological Chemistry*.

Galileo was born in 1564 and was the first great modern scientist who chose to trust his own observations rather than accept the teachings of authorities. In 1633 he was forced by

the Inquisition to renounce his teachings. This was five years after the publication of Harvey's discovery of the circulation of the blood, which the intellectual world received with merciless criticism as being contrary to the doctrines of Galen. These were also the days of the Thirty Years War in Germany, a war of religious intolerance.

In 1651 Harvey published his "De Generatione," which was the finest piece of observation and analysis of his day. In 1656 he transferred property to his college which yielded an income of fifty-six pounds to be used as a salary for a librarian and to found an annual oration the object of which was "to search out and study the secrets of nature by way of experiment."

In 1660 the Royal Society of London was founded, the progenitor of which was the Royal Society Club, the oldest club in Europe. This latter was made up of men who clubbed together and ate their meals at a tavern, and the club still continues to dine weekly in London, drinking three toasts, "The King," "The Arts and Sciences" and "The Royal Society."

In Robert Boyle's "Hydrostatical Paradoxes," printed at Oxford in 1666, the preface begins:

> The Rise of the following Treatise being a Command imposed on me by the Royal Society.

Instead of being persecuted as Harvey had been, Boyle had the support of his friends of the Royal Society. On the last page of Boyle's volume he describes a biological experiment in which he had placed a tadpole under pressure equal to that of a column of water between two or three hundred feet high and concludes as follows:

> And yet all this weight being unable to oppress, or so much as manifestly to hurt, the tender Tadpole (which a very small weight would suffice to have crushed if it prest only upon one part of it and not on the other) we may thence learn the Truth of what we have been endeavoring to evince: That though water be allowed to press against water and all immersed Bodys; yet a Diver may well remain unoppressed at a great depth under water as long as the pressure of it is uniform against all the parts exposed thereunto.

We learn from this application of the Law of Pascal ("the ingenious Monsieur Pascal," Boyle calls him) how quickly the age of historical research liberated the mind so that an age of experimental observation set in.

Another hundred years roll around and bring to us the eccentric Cavendish, who discovered hydrogen and who was also a faithful attendant of the Royal Society; and Lavoisier, the master scientist of France; and our own Benjamin Franklin and Benjamin Thompson, the latter also known as Count Rumford.

Although the first half of the last century was a brilliant era in French science, it was not until about 1850 that Germany fully dissociated science from speculative philosophy and entered the field of scientific progress. Liebig, a pupil of Gay-Lussac, brought into Germany from Paris the knowledge of chemistry as it had been expounded by Lavoisier and Berthollet. It should be remembered that in the Middle Ages until 1618 Germany was a land of peaceful traders and there arose important cities, such as Augsburg and Nuremburg. In the latter city Hans Sachs had composed 6,000 pieces of poetry and Dürer had painted his wonderful masterpieces. It was a time of prosperity and cultivation, in evidence of which free public baths were being introduced into the cities in imitation of the Roman establishments. Then came the Thirty Years War, between 1618 and 1648, which is said to have reduced the population of Germany from 30,000,000 to 5,000,000 inhabitants. This war, carried on between Protestants and Catholics, brought abject poverty to the people, who reverted well nigh into barbarism. Germany was in this condition at the time of the founding of the Royal Society of London. Leibniz, who had visited Paris and London, was the founder and first president of the Academy of Sciences at Berlin which dates from the year 1700.

It is interesting to note that the town of Munich was put in orderly condition by Benjamin Thompson, who was born in the neighborhood of Concord, New Hampshire. Thompson, who was created Count Rumford, was a scientist of distinction and his work upon heat

is acknowledged to be accurate and true. He exercised great influence in the kingdom of Bavaria and especially in the town of Munich. He found the soldiers indolent and he put them to work upon the land, thereby increasing the food supply. He studied the principles of stoves so that cooking might be done in the most economical manner. In 1790 he caused the soldiers to arrest within one week 2,600 beggars and vagabonds, who were also potential thieves, and put them to work, directing that it all be done in a kindly manner. This large number of indigents came from a total population of 60,000. Soup kitchens were provided and a soup made of bones and blood, the cheapest slaughter-house materials, was furnished for these workers. In this way he completely abolished poverty. The beautifully planned English Garden in Munich is another evidence of Count Rumford's capacity. This is a historical example of a distinguished scientific man in complete charge of a government. It finds a modern counterpart in the control of the Panama Canal Zone by General Gorgas.

The marvelous growth of German science since 1850 has been the admiration of the world. To the severely critical it may possibly seem to have passed through two stages; a first stage, that of the study of science for the love of finding out the truth, and a second stage, the study of science, because, as a German professor once wrote me, "pride in a scientific reputation as an incentive to ambition is not to be underestimated." One may also point out that no other nation more completely adopted the doctrines of Darwin, and that Koch continued the brilliant lead of Pasteur.

The other day, when speaking to my students of the work of Otto Neubauer upon the method of the deamination of amino-acids within the body, I called attention to the fact that this fine piece of work was not done in a chemical nor yet in a physiological institute but in the laboratory of the second medical clinic of Friedrich Müller in the town of Munich; that though we could celebrate with joy our victories over that vicious symposium of evil known as Prussian militarism, the leaders of which in cowardly manner have slunk out of harm's way, yet it would be unworthy of us if we could not continue to celebrate German triumphs of peaceful, scientific achievement.

About ten years ago I was in Berlin and heard bitter complaint that there was no money for new hospital buildings, no money for new laboratories, and all this because the Kaiser must have money for his new toys, battleships which were to be constructed. To-day, where are those battleships? Gone. Gone, also, the Kaiser. But the Charité Hospital in Berlin, with all that it has stood for in the history of medicine, still stands. Its past, at least, will endure and we have no right to wish anything for it but an equally brilliant future.

For the moment let us remember Longfellow's poem on Nuremburg:

Vanished is the ancient splendor, and before my dreamy eye
Wave these mingled shapes and figures, like a faded tapestry.
Not thy Councils, not thy Kaisers, win for thee the world's regard;
But thy painter, Albrecht Dürer, and Hans Sachs thy cobbler-bard.

There is only one thing that would be more stupid than our failure to recognize the importance of German scientific achievement and that would be that the Germans, having suffered disastrous and fitting punishment for the evil of their ways, should decide to exclude the thoughts and ideas, whether of morals, of art or of science, of those with whom they had lately been at war.

In the field of hospital nursing American institutions have long been preeminent. As a nation we have developed the quality of mercy to a high degree. This quality of mercy has been distinctly lacking in both the German character as well as in the administration of very many of their hospitals. But this quality of mercy is not the whole equipment of a modern physician, else the trained nurse or the Christian Science reader would be all-sufficient for assuaging the physical woes of mankind. Very much more than this is demanded of the physician, who has to interpret the derangements of the human body and attempt a recon-

structive program. This knowledge can be obtained only from the biological sciences as applied to medicine.

It is interesting to follow the teachings of the brilliant school of French scientists which made Paris the rendezvous of the illustrious men of the continent. Lavoisier, in his "Elements of Chemistry," quotes the then recently deceased French philosopher, the Abbé de Condillac as follows:

> Instead of applying observation to the things we wished to know, we have chosen rather to imagine them. Advancing from one ill-founded supposition to another, we have at last bewildered ourselves amid a multitude of errors. These errors, becoming prejudices, are, of course, adopted as principles, and we thus bewilder ourselves more and more. The method, too, by which we conduct our reasonings is absurd. We abuse words which we do not understand, and call this the art of reasoning. When matters have been brought this length, when errors have been thus accumulated, there is but one remedy, by which order can be restored to the faculty of thinking; this is, to forget all that we have learned, to trace back our ideas to their source, to follow the train in which they rise, and, as Lord Bacon says, to frame the human understanding anew.

It is readily seen that such a standpoint as this, as well as that developed by Lavoisier and quoted at the beginning of this paper, would affect the ideas of thoughtful medical men. The French physiologist Magendie, who lived a generation later than Lavoisier and who was the founder of experimental physiology, wrote in 1836 in his "Elements of Physiology" the following words:

> In a few years physiology, which is already allied with the physical sciences, will not be able to advance one particle without their aid. Physiology will acquire the same rigor of method, the same precision of language and the same exactitude of results as characterize the physical sciences. Medicine, which is nothing more than the physiology of the sick man, will not delay to follow in the same direction and reach the same dignity. Then all those false interpretations which, as food for the weakest minds, have so long disfigured medicine, will disappear.

And this same idea was preached by Magendie's most distinguished pupil, Claude Bernard, when he said:

> The prudent and reasonable course is to explain all that part of disease which can be explained by physiology, and to leave that which we can not so explain to be explained by the future progress of biological science.

In considering science as a factor of human knowledge it is necessary to dissociate the mind from that provincialism which would hold that each country has its own special kind of science, a form of pleading which Rubner once endeavored to expound. American students, with their extreme loyalty to everything which may be good or bad about the educational institution to which accident may have attached them, are inclined to be narrow enough without accepting such a doctrine as this. The truth is the same whether it be in Boston or New York; in London, Paris or Berlin. Only the interpretation of the truth varies with the education of the mind of the individual. The inspiration and opportunity for seeking for the truth depends also on the human factors involved.

Before the war medical education in this country was rapidly advancing. In all the great centers men lived whose primary pleasure was the search for understanding regarding the complex processes of life in health and in disease. Such work brings joy to the worker or he would not do it. I recall a talk with my friend, Phoebus Levene. He had given a student the problem of finding the formula for chondroitin sulphuric acid and a year had passed without result. Levene said to his pupil:

> Work another year and then you will have it, and when all these men whose names are in the papers every day are dead, buried and forgotten, some one, long hence, when passing by will see this formula and will say of you "he painted that little picture."

To what extent this doctrine of future reward may affect the scientific seeker after knowledge can not be told, but there is no doubt that the chief origin of successful research lies in the love of it, and the joy of

discovery of new things and their understanding. Of course, there are many factors which enter into the life of the adventurer into the unknown. One of the most powerful controls in scientific life is criticism. Pflüger has stated that criticism is the mainspring of every advance. Scientific criticism begins with the scientist himself, and then he extends it to others and in turn receives external aid in the revision of his own opinions. Sometimes this criticism is friendly; sometimes bitter. Questions of priority also arise. It seems that in the future the most courteous treatment would be to commence all polemical discussions under the caption "The errors of the author and his critics" and to remember that as far as priority is concerned a man's influence is equal to the sum of all the influences of his life and that questions of priority as between men are usually insignificant and unimportant. I overheard one of Voit's assistants say to him, "Your views, Professor, are bound to win" and Voit turned upon him in anger, saying, "It makes no difference *who* is right, so long as the truth is found."

The quality of mind is of interest in considering scientific types. Liebig was a dunce at school and his teacher ridiculed his ambition to become a chemist. Helmholtz studied the refraction of light with a prism under his desk during Latin recitations when he was a boy. Helmholtz, on the occasion of his seventieth birthday, stated that he had never had a great idea come to him when he was at his desk, nor when he was tired, nor after taking a glass of wine, but usually such had come to him when he was walking in the garden musing of other things. The scientist must have leisure to think over the problems which offer and he must have a certain discrimination in order to distinguish between the things which are worth doing and those which are not. To do this requires a certain delay in action in order that plans may be matured. The individual who can not be happy unless he is at work at full power all the time is much less likely to accomplish successful scientific work than he who will not commence a research until he has satisfied himself that it is worth doing. It is not to be denied that this essential qualification of scientific life is frequently regarded with scorn by the busy practitioner of medicine, who gives himself no time either for thought or study.

Though the capacity for discovering new things may not be given to all, yet all should have the training which comes from an environment, such as that existing in the Harvard Medical School, where the students are educated by men whose lives have been illumined by creative thought. Such men are patrons of the future, benefactors of mankind.

The war brought a temporary halt to promising activities. Many instances can be cited. In Bellevue Hospital Du Bois had just completed his calorimetric studies upon malarial fever. He was investigating the water output of the body during the night sweats in tuberculosis and, for the first time, the technic had been perfected so that this factor in the regulatory mechanism of the heat control could be studied. The declaration of war against Germany meant "down tools" for him, and he gave his services to his country. The important point now is to have the work completed with as little delay as possible.

But the war has also developed much that is of great value to the nation and medical science has been notably advanced in many lines. The work on "Trench Fever," edited by Major Richard P. Strong, of the Harvard Medical School, is one of the great medical triumphs of the war. It seems as though the value of science for the welfare of the nations of the world must have become more firmly defined in the minds of men than ever before. Let us hope that this is true.

Now is the time to take up the work where it was left at the outbreak of the war. It is our duty not only to continue but also to expand the work—to multiply facilities and to furnish a living wage. Scientific laboratories everywhere should be free from all commercial taint, which distracts and finally destroys. A laboratory should be a little community, happy in its daily life, and doing work worth

while for the advancement of knowledge. The actual workers therein should be full-time men. Whether the titular chief should always be such is an undecided question and is largely dependent upon the personal equation.

Such laboratories as these are the glory of the Harvard Medical School. To the young men who are to be the leaders of the future belongs the present opportunity. The lands of Europe are wasted and impoverished by war. Only the wounded and the physically unfit were allowed to study medicine in England last winter. The men of England and the men of France have fought for four long years; ours for four months. The young physicians of America of the present generation have the obligation and may, perhaps, deserve the credit of establishing in the days to come, the dreams for medicine of Magendie and of Claude Bernard, thus insuring a notable scientific era in this great land of ours. Only thus can medicine progress; only through observation and experiment can the world grow in wealth of knowledge. We may thus endeavor, "as Lord Bacon says, to frame the human understanding anew."

Graham Lusk

THE SMITHSONIAN "SOLAR CONSTANT" EXPEDITION TO CALAMA, CHILE

In 1916 Secretary Walcott appropriated from the income of the Hodgkins Fund to equip and maintain for several years such a station in South America, but owing to the war it was temporarily located in the North Carolina mountains in 1917. The station proved very cloudy, and now it has proved possible though very expensive to go to Chile.

Dr. C. G. Abbott has reported to the National Academy of Sciences that after correspondence with the South African, Indian, Argentine and Chilean meteorological services he became convinced that near the nitrate desert of Chile is to be found the most cloudless region of the earth easily available. Dr. Walter Knoche, of Santiago, has most kindly furnished two years (1913 and 1914) of unpublished daily meteorological records for a number of Chilean stations. In his judgment the best station is Calama on the Loa River, Lat. S. 22° 28′, Long W. 68° 56′, altitude 2250 meters. For the two years the average number of wholly cloudless days is at 7 A.M., 228; 2 P.M., 206; 9 P.M., 299; and of wholly cloudy days, none. The precipitation is zero; wind seldom exceeds 3 on a scale of 12; temperature seldom falls below 0° or above 25° C.

The expedition, Director Alfred F. Moore, Assistant Leonard H. Abbot, reached Calama June 25, 1918, equipped with a full spectro-bolometric, pyrheliometric and meteorological outfit of apparatus, as well as with books, tools, household supplies and everything foresight could furnish to make the work successful and life bearable. The Chilean government has facilitated the expedition in many ways, and the Chile Exploration Company has given the expedition quarters and observing station at an abandoned mine near Calama. Many others in Antofagasta, Chuquicamata and Calama have been of great assistance.

The apparatus is set up in an adobe building about 30 feet square, in which the observers have sleeping apartments. A 15-inch two-mirror coelostat reflects the solar beam to the slit of the spectro-bolometer. A Jena ultra-violet crown glass prism and speculum metal mirrors are used in the spectroscope The linear bolometer is in vacuum, and constructed in accord with complete theory for greatest efficiency. Its indications as measured by a highly sensitive galvanometer are recorded photographically on a moving plate which travels proportionally to the movement of the spectrum over the bolometer. Successive bolometric energy spectrum curves each occupying 8 minutes of time are taken from early morning till the sun is high and are thus recorded on the plate. Their intensity indications at 40 spectrum positions are reduced by aid of a special slide rule plotting machine.

A pair of silver disk pyrheliometers is read simultaneously with each spectro-bolographic determination. Measurements of humidity, temperature, and barometric pressure accom-

pany the bolometric observations. Also a pyranometer is employed to determine the sky radiation.

The young men find pleasant companions at the great copper mine at Chuquicamata. At present they are boarding with a Chilean family at Calama, but as both are good cooks they may wish to board themselves. The railway and the river both pass the town of Calama, so that there is no such desert isolation as might be feared. To the east are the Andes Mountains. The peaks in that neighborhood rise to 16,000 or 17,000 feet. Some are volcanic but none of these are very near.

It is hoped that the work will be continued for several years at least, and that nearly daily observations may be obtained. The application of the results to meteorology is something which may prove to have great possibilities. To exploit them a long and nearly unbroken series of solar radiation observations must be obtained.

Observations were begun on July 27, under exceptionally favorable conditions of the experimental equipment. At latest report, on October 22, complete solar constant determinations had been made on five days in July, twenty-seven days in August, eighteen days in September and nineteen days in October, a total of sixty-nine days out of eighty-eight days elapsed.

Owing to the great zeal and industry of the observers and the excellent special computing facilities at their disposal, all of the observations had been completely worked up to date. If necessary for meteorological purposes it would be possible for them to telegraph the solar constant value on the same day observed.

Notwithstanding the high percentage of cloudless days, the sky conditions have not proved quite as satisfactory as had been hoped, owing to the presence of considerable haze and the occasional formation of cirrus clouds. While these modifications of transparency are not serious enough to introduce large errors in the results (all values have fallen between 1.88 and 2.02 calories) they are serious obstacles to the investigation of variations of the sun which should be measured to one per cent. of the solar constant or better. Efforts are now being made with good prospect of success to devise an instantaneous method of determining the sky transparency so as to avoid error from changes of transparency occurring progressively during several hours.

The average value of the solar constant as thus far obtained at Calama is 1.951 calories per square centimeter per minute. The mean of all values obtained prior to 1914 was 1.932. At present the solar activity as measured by sun-spots is still large, though declining. In view of the past measurements of the solar constant and past investigations of the meteorological phenomena of the world it is to be expected that somewhat lower values of the solar constant and somewhat more cloudless observing conditions will be found at Calama after a year or two.

THE HARVARD ENGINEERING SCHOOL

Following the decision of the Supreme Court of Massachusetts that the agreement with the Institute of Technology is not in accord with the will of the late Gordon McKay, Harvard has reorganized its engineering school on a basis satisfactory both to the trustees of the McKay estate and to the governing boards of the university. The new plan, however, will be subject to the approval of the Court. The full text of the vote passed by the Harvard Corporation and consented to by the Board of Overseers establishing the school follows:

Voted to establish a School of Engineering upon the following basis:

Whereas, in reconstructing an engineering school in Harvard University it is important to lay stress upon fundamental principles; to make use of the courses in Harvard College so far as is consistent with the curriculum of the school; and to conduct the school under a faculty of its own the corporation hereby adopts the following plan of organization:

1. Name. The name of the school shall be the Harvard Engineering School.

2. Departments. The school shall provide "all grades of instruction from the lowest to the highest" and the instruction provided shall "be kept

accessible to pupils who have had no other opportunities of previous education than those which the free public schools afford."

3. Admission. Inasmuch as the entrance examinations to Harvard College now admit freely boys from good high schools, the requirements for admission to the engineering school shall be the same as for admission to Harvard College. Admission to advanced standing and special study shall be administered by the engineering faculty.

4. Fees. The fees of students in the school shall be the same as for students in Harvard College, except that supplementary fees for additional or for laboratory courses may be charged.

5. Class rooms and laboratories. The work of the school shall be carried on in the class rooms and laboratories of the university, but arrangements may be made from time to time for the use of the facilities of other institutions for any part of the work (in its advanced technical courses) when the needs, financial resources and best interests of the school so require.

Arrangements for the use of facilities of other institutions, or the interchange of instruction, shall be made for a period of only one year at a time.

When there shall be income from the funds of the McKay endowment available, in the judgment of the president and fellows, for the construction of new buildings for the engineering school, containing offices, laboratories, workrooms and classrooms, such buildings are to be constructed on Harvard University grounds and bear the name of Gordon McKay.

6. Faculty. The faculty of the school shall consist of the president of the university and of those professors, associate professors, assistant professors and instructors appointed for more than one year, the greater part of whose work of instruction is done in the school, and of a limited number of other teachers of subjects offered in the school to be appointed in the usual way. The term of appointment of a teacher from any other institution who gives instruction in the school shall be for one year only; his title shall be lecturer, instructor or assistant.

The faculty shall, under the direction of the corporation, have control of all instruction given in the school wherever the instruction may be given.

7. Degrees. A student satisfactorily fulfilling the requirements of a prescribed four-year program in any of the engineering fields shall be awarded the degree of bachelor of science in that field.

The degree of master of science, or an equivalent degree, shall be awarded upon the successful completion of at least one additional year of study. For the doctor's degree the requirements shall be similar to those in the graduate school of arts and sciences.

8. Credit for instruction elsewhere. As in the case of every faculty the faculty of the engineering school may, in its discretion from time to time, allow credit towards the degree under its control for instruction received at another institution or by other instructors.

9. Courses in the school, or the services of its staff, may be made available to qualified students of other institutions.

10. This plan shall be submitted to the Supreme Judicial Court of Massachusetts, or a justice thereof, for approval.

The faculty of the school of engineering is as follows:

A. Lawrence Lowell, president; George F. Swain, Gordon McKay professor of civil engineering; George S. Raymer, assistant professor of mining; Arthur E. Kennelly, professor of electrical engineering; Henry L. Smyth, professor of mining and metallurgy, and director of the mining and metallurgical laboratories; Harry E. Clifford, Gordon McKay professor of electrical engineering; Lewis J. Johnson, professor of civil engineering; Albert Sauver, professor of metallurgy and metallography; George C. Whipple, Gordon McKay professor of sanitary engineering; Comfort A. Adams, Abbott and James Lawrence professor of electrical engineering; Frank A. Kennedy, associate professor of engineering drawing; Lionel S. Marks, professor of mechanical engineering; George W. Pierce, professor of physics and director of the Cruft Memorial Laboratory; Hector J. Hughes, professor of civil engineering and director of the engineering camp; Edward V. Huntington, associate professor of mathematics; Gregory P. Baxter, professor of chemistry; Lawrence J. Henderson, assistant professor of biological chemistry; Louis C. Graton, professor of economic geology; Arthur E. Norton, assistant professor of mechanical engineering; Harvey N. Davis, assistant professor of physics; Grinnell Jones, assistant professor of chemistry; Emory L. Chaffee, assistant professor of physics.

THE MEDALLISTS OF THE ROYAL SOCIETY

AT the anniversary meeting of the Royal Society on November 30, medals were pre-

sented by the president, Sir J. J. Thomson, as announced in last week's issue of SCIENCE. The characterization of the work of the medallists, as printed in *Nature*, was as follows:

The Copley Medal is awarded to Hendrik Antoon Lorentz, For. Mem. R. S. Lorentz is generally recognized as one of the most distinguished mathematical physicists of the present time. His researches have covered many fields of investigation, but his principal work deals with the theory of electrons and the constitution of matter considered as an electro-dynamic problem. When Zeeman had discovered the effect of magnets on spectroscopic lines, he perceived at once the theoretical bearing of the effect, which led to the discovery of the circular polarization of the components of the lines split up by magnetic force. Lorentz's name is also associated with that of Fitzgerald in the independent explanation of the Michelson-Morley effect, from which far-reaching consequences have been derived. An important optical relationship between the density of a medium and its index of refraction (independently by L. Lorentz) was published in 1878, and he has been an active and fruitful investigator ever since.

A Royal Medal is awarded to Professor Alfred Fowler. Professor Fowler's investigations have been, in the main, on spectroscopy, and one of his specialties has been the identification and reproduction of celestial spectra in the laboratory. His extraordinary success in identification of this kind is attributable in part no doubt to a special intuition, but also to a great and laboriously acquired knowledge of detail. For instance the origin of the bands dominating the spectra of stars of Secchi's third class remained a mystery for many years. Fowler showed that they were due to titanium oxide. He accounted for many of the band-lines in the sun-spot spectrum by showing that they belonged to "magnesium hydride," and several other instances of scarcely less importance might readily be given. Another important branch of his work is connected with spectrum series. The lines of many elements which appear in the arc spectrum have long been classified into series, and empirical relations have been obtained between the position of a line in the series and its frequency of oscillation. Those lines which are characteristic of the spark, and require higher stimulation, were not included in the scheme. Fowler was the first to show that the spark-lines form series at all. For this purpose he had first to work out experimentally the conditions for obtaining an adequate number of lines belonging to these series. Helium and magnesium were the elements chiefly studied. It was found that the spark-line series could be represented by formulæ similar to those which hold good for the arc lines, but with a fourfold value of the universal constant holding for the arc-line series of all the elements.

Apart from these investigations, leading to results so simple and definite, there is much descriptive work on spectra standing to the credit of Professor Fowler and his pupils, which is highly appreciated by specialists for its accuracy and technical value.

A Royal Medal is awarded to Professor Frederick Gowland Hopkins. Professor Hopkins was among the very earliest, if not actually the earliest, to recognize and announce that minute quantities of certain bodies, the nutritive value of which had hitherto been unsuspected, exert an enormous influence upon growth and upon normal adult nutrition. He showed that without these accessory factors—vitamines—a diet otherwise full and seemingly complete is incapable of allowing growth, and even of maintaining body-weight or life. He has also made important researches into what may be styled the determination of the specific nutritive values of individual main components of the protein molecule; he has, for example, shown that when, from a certain diet which was proved to maintain nutrition satisfactorily, the two amino-acids, arginine and histidine, were together removed, the diet, though amply sufficient in energy and fully assimilable, failed to maintain life. More recently Hopkins has attacked the question whether an animal's life can be maintained under the condition that, in place of protein or of the entire set of amino-acids constituting protein, a limited few of the several representative types of these constituents are provided in the diet. He shows that when, instead of the eighteen different amino-acids composing the protein, five only are administered, death rapidly ensues if those five be selected from the simpler aliphatic components, *e. g.*, lucine, valine, alanine, glycine and glutamic acid, but that, on the other hand, nutrition and life are satisfactorily maintained, at least for a considerable period, if the five amino-acids given be chosen from the more complex types, such as tyrosine, tryptophane, histidine, lysine and cystine, which experiment has shown to lie outside the range of the synthetic power of the animal body.

The Rumford Medal is awarded to Dr. A. Perot and Professor Charles Fabry. MM. Perot and Fabry have introduced a new method of measuring

wave-lengths by an ingenious method of utilizing the luminous rings formed by interference between two reflecting plates. Their researches have proved of fundamental importance: (1) In comparing accurately the wave-lengths of different spectroscopic lines with that of some standard line. (2) In comparing directly the wave-length of the standard line with that of the standard unit of length. This comparison has confirmed in a remarkable way the previous measurements of Michelson, whose method is less direct and more liable to certain errors. The independent confirmation thus obtained has therefore placed the subject on a much firmer basis.

The Davy Medal is awarded to Professor F. Stanley Kipping. Professor Kipping has worked with distinction during the past thirty years on a great variety of problems connected with organic chemistry, involving fatty acids, derivatives of hydrindone, camphoric acid and its halogen compounds, the π-derivatives of camphor, racemism and pseudo-racemism, derivatives of quinquevalent nitrogen, organic compounds of silicon, including derivatives having optical activity due to the asymmetry of the silicon atom.

The Darwin Medal is awarded to Dr. Henry Fairfield Osborn. Dr. Osborn's chief work has been in paleontology, and, in connection with it, he has organized many collecting expeditions to the early Tertiary rocks of the west. One of the results of his work is the more precise determination of the relative ages of the extinct mammals in North America, and that has led to a correlation between the order of succession of the Mammalia in Europe and in America. A good deal of this work was summarized in his book, "The Age of Mammals in Europe, Asia and North America," published in 1910. In 1900 Osborn had come to the conclusion that the common ancestors of Proboscidia, Eirenia and Hyracoidea would be found in Africa; and the correctness of this view has since been confirmed by Dr. Andrew's discoveries in the Egyptian Fayum. Amongst the more important of Osborn's contributions to our knowledge of extinct vertebrata are his memoirs on the rhinoceroses, the horses, the titanotheres and the dinosaurs. In addition to all the work he has done personally, Dr. Osborn has had a wide and most beneficial influence upon biological research in North America, and he has produced a flourishing school of younger vertebrate paleontologists.

The Hughes Medal is awarded to Mr. Irving Langmuir. Mr. Irving Langmuir is a distinguished worker in the physics and methods of production of high vacua. He has studied the vapor pressure of platinum and molybdenum by heating fine wires *in vacuo* and noting the loss of weight. He has investigated the speeds of chemical reaction of different gases on various metals at very low pressures. He has investigated also the dissociation of hydrogen and its apparent abnormal heat conductivity, and the dissociation of chlorine and oxygen; also the chemical activity of dissociated hydrogen. His work on the emission of electrons from hot metals in high vacua led to the evolution of the "kenotron" and "pliotron," and of the "half-watt" lamp. His determination of the melting-point of tungsten is generally accepted. Much of his work, such as the investigation of the cause of blackening of tungsten lamps, is of commercial as well as of academic scientific value.

SCIENTIFIC EVENTS

THE BRITISH MEDICAL RESEARCH COMMITTEE[1]

UNDER the regulations for the Medical Research Fund Major Waldorf Astor, M.P., Dr. A. K. Chalmers (M.O.H. Glasgow), and Dr. George Murray, professor of medicine in the University of Manchester, retired last August. Major Astor was reappointed Chairman, and Dr. Henry Head, F.R.S., physician to the London Hospital and to the Royal Air Force Central Hospital, and Dr. Noël Paton, F.R.S., regius professor of physiology in the University of Glasgow, were appointed members of the Committee. It now consists, in addition to Major Astor (Chairman), Viscount Goschen (Treasurer), and Sir Walter Fletcher, M.D., F.R.S. (Secretary), of Dr. Addison M.P., Mr. C. J. Bond, of Leicester, Professor William Bulloch, F.R.S., Professor F. G. Hopkins, F.R.S., of Cambridge, Colonel Sir William Leishman, K.C.M.G., F.R.S., Dr. Henry Head, and Professor Noël Paton. Reference is made elsewhere (p. 579) to some of the chief points in the annual report. We may note in addition the statement that the committee has acted jointly with various government departments or other bodies, either in appointment or in nomination, with a view to meeting particular administrative needs demanding research work. The committee has in fact a

[1] From the *British Medical Journal*.

number of special committees, including those on the incidence of phthisis in relation to occupation; on surgical shock and allied conditions of which Professor Bayliss has become chairman; on the standardization of pathological methods, of which Professor Adami, F.R.S., is chairman; on salvarsan; on chemical warfare medical investigations; on anaërobic bacteria and infections, of which Professor Bulloch is chairman; on accessory food factors ("vitamines"), of which Professor Hopkins is chairman; on air medical investigations, of which Dr. Head is chairman; and on dysentery, of which Sir William Leishman is chairman. There is also an industrial fatigue research board, appointed last June by the Department of Scientific and Industrial Research jointly with the Medical Research Committee, to consider and investigate the relations of the hours of labor and of other conditions of employment, including methods of work, to the production of fatigue, having regard both to industrial efficiency and of the preservation of health, among the workers. Of this committee Professor Sherrington is chairman. In the introduction to the annual report reference is made to the cordial cooperation received from the Advisory Council of Scientific and Industrial Research, established in 1915. The field of research in every pure science, not less than that of inquiry in industrial science, lies so close at very many points to the fields of medical research, that no boundary line can be drawn. The committee looks forward to the progressive development in this cooperation with the department of scientific and industrial research, and finds new hope for the increasing effective organization of research work in all directions. "This," it is said, "should be an organization not imposed in any sense from above, but one derived from and inspired by the efforts of individual workers in the different fields of science, where the free university and other institutions of the country are pursuing together the common aims of the advancement of knowledge and the good of the state." In this connection it may be recalled that the Ministry of Health Bill provides that "the duties heretofore performed by the Medical Research Committee shall, after the commencement of this act, be carried on by or under the direction of a committee of the Privy Council appointed by His Majesty for that purpose." This would place the Medical Research Committee in a position analogous to that of the Advisory Council of Scientific and Industrial Research.

RESOLUTIONS IN HONOR OF DIRECTOR FREDERICK J. V. SKIFF

On the sixteenth of December Dr. Frederick J. V. Skiff, director of the Field Museum of Natural History, Chicago, was presented with engrossed resolutions by eighty-six of those affiliated with him in the museum, the occasion for this presentation being the twenty-fifth anniversary of the appointment of Dr. Skiff as director of the Field Museum. Dr. Skiff was the recipient of many congratulatory letters and telegrams. The resolutions are as follows:

On this, the occasion of the twenty-fifth anniversary of your appointment as director of this museum, we who are affiliated with you in the work of the museum unanimously extend to you our hearty congratulations upon your successful completion of so notable a term of service, and wish to express to you as well, our deep appreciation of the cordial relations which you have maintained with us during this period.

The task to which you were called twenty-five years ago presented, as we realize, peculiar difficulties. The plan and purpose of the museum were to some extent uncharted and the execution of even such plans as had been made called for the exercise of unusual administrative ability. The opportunity at hand at this time for creating a museum of world-wide scope and importance was known to be great, but the manner in which this opportunity should be improved, so far as administrative details were concerned, rested with you. With what high idealism, fixity of purpose and wisdom of direction you performed this task, the institution which exists to-day eloquently testifies. Whatever great accomplishments of service and progress await the museum in the future, we feel sure that it will always owe its success to the broad foundations which it has been your privilege and at the same time your high honor to have laid. Only one of broad, well-balanced and highly cul-

tured mind could have conceived and carried on as you have done the symmetrical and rapid progress which has characterized the institution. That in addition to this great work you have been able also to render highly distinguished services to various international enterprises in the form of world expositions, is another indication of the wide range of your powers.

Your broad qualities of mind have been accompanied by a warmth of heart which has bound us to you in especial affection. Our felicitations on this occasion spring therefore from sentiments of deep personal regard. You have been to each of us a wise counselor and faithful friend, no less than trusted leader and able administrator.

It is our hope that you may be spared to direct the activities of this institution for many years and to enrich with your friendship and counsel the lives of each of us and of all others who shall be privileged to come within the circle of your companionship.

THE WORK OF DR. C. G. ABBOT

DR. CHARLES GREELEY ABBOT has been appointed assistant secretary of the Smithsonian Institution. Dr. Abbot was born in Wilton, New Hampshire, May 31, 1872. He was graduated from the Massachusetts Institute of Technology, class of 1895, with the degree of Master of Science, and in 1914 he was awarded the Honorary Degree of Doctor of Science by the University of Melbourne.

Dr. Abbot was appointed assistant to Secretary Langley in the Smithsonian Astrophysical Observatory in 1895, and has been engaged continuously in original researches on solar radiation in cooperation with Dr. Langley up to 1906, when he assumed entire charge of that work as director. His studies covered the fundamental problems in connection with the amount and variability of solar radiation, its absorption in the solar and terrestrial gaseous envelopes, and the effects of its variability on climate.

In recognition of the character of his work, Dr. Abbot has received the Draper gold medal from the National Academy of Sciences, the Rumford gold medal from the American Academy of Arts and Sciences, and membership in the National Academy of Sciences, the American Academy of Arts and Sciences, the Astronomical and Astrophysical Society of America, the Royal Astronomical Society of Great Britain, the Société Astronomique de France, the Society of Astronomy in Mexico, the Academy of Modena in Italy, the Deutsche Meteorologische Gesellschaft in Germany, and other organizations. The results of his work have been published largely in the *Annals* of the Astrophysical Observatory. He is also the author of a work entitled "The Sun," published in 1911, and has contributed many scientific papers to special astronomical and astrophysical journals.

THE ANNUAL MEETING OF THE AMERICAN ORNITHOLOGISTS' UNION

THE thirty-sixth annual meeting of the American Ornithologists' Union was held in New York City, November 11, 1918. Owing to the epidemic of influenza the public meetings for the presentation of papers were omitted and the sessions were limited to business meetings of the council and fellows and members. The election of officers resulted in the choice of the following officers for the ensuing year: *President*, John H. Sage, Portland, Conn.; *Vice-presidents*, Dr. Witmer Stone, Philadelphia, and Dr. George Bird Grinnell, New York; *Secretary*, Dr. T. S. Palmer, 1939 Biltmore St., Washington, D. C.; and *Treasurer*, Dr. Jonathan Dwight, New York. Five additions were made to the list of honorary fellows and 14 foreign ornithologists were enrolled as corresponding fellows. The honorary fellows elected were: Dr. Roberto Dabbene, of Buenos Aires; Dr. Alwyn K. Haagner, of Pretoria, Transvaal; Dr. Einar Lönnberg, of Stockholm, Sweeden; Dr. Auguste Ménégaux, of Paris, and Dr. Peter Suschkin, of Kharkov, Russia. Five new members, Dr. Harold C. Bryant, George K. Cherrie, Lieutenant Ludlow Griscom, Lieutenant J. L. Peters and R. W. Williams, and 147 associates were added to the rolls.

Although the union has had seventy-five of its younger and more active members in military and naval service, it has survived the war without suffering any decrease in its membership, its income, or in the size of its journal.

It has not found it necessary to increase its dues and the past year has proved one of the most prosperous in its history.

The next meeting in 1919 will be held in New York City.

SCIENTIFIC NOTES AND NEWS

This number of Science completes twenty-four years of weekly publication under the present editorial management. The New Era Printing Company have been the printers of the journal during this period, and it is becoming to put on record its obligation to them for efficient and distinguished work.

The American Association for the Advancement of Science and the national scientific societies affiliated with it are meeting this week at Baltimore, the opening session being held on the day the present issue of Science is mailed. We hope to print next week the address of the retiring president, Professor Theodore W. Richards, to be followed by the addresses of the vice-presidents and other addresses and papers presented at the meeting.

Dr. A. Smith Woodward, keeper of the Geological Department of the British Museum (Natural History), has been awarded the Cuvier prize by the French Academy of Sciences.

Sir Herbert Jackson has been appointed director of the British Scientific Instrument Research Association. He has resigned from the Daniell professorship of chemistry, King's College, London.

Lieutenant Colonel Raffaele Bastianelli, professor of surgery in the University of Rome, has been elected an Honorary Fellow of the New York Academy of Medicine.

Professor G. F. Novaro retires this year from the chair of clinical surgery at the University of Genoa, having reached the age of seventy-five. He is a senator of the realm.

Lieutenant Colonel Frank P. Underhill, commanding officer of the Yale Chemical Warfare Unit, has recently returned from France, where he went to introduce a cure for men gassed at the front. This new method was adopted.

Dr. A. O. Leuschner, of the University of California, will relinquish the duties of dean of the graduate division at the university at the end of the academic year, and has received a commission as major, Chemical Warfare Service, with headquarters at Washington, and has been detailed to the National Research Council since the armistice. Captain W. H. Wright, astronomer in the Lick Observatory, is connected with the Range Firing Section, Ordnance Corps, Aberdeen Proving Ground. Dr. H. D. Curtis, astronomer in the Lick Observatory, is engaged in war work at the Bureau of Standards. Dr. Russell Tracy Crawford, assistant professor of astronomy in the University of California, is major in the Signal Corps, U. S. Army, at the Air Balloon School, Ft. Omaha. Dr. Dinsmore E. Alter, instructor in astronomy, University of California, recently appointed assistant professor of astronomy and physics, University of Kansas, is major in the Coast Artillery Corps, U. S. Army, in charge of the Enlisted Specialists School, Ft. Scott, California. Wallace Campbell, fellow in astronomy at the University of California, lieutenant in the engineer Corps, U. S. Army, is in France with the Expeditionary Forces.

Dr. Hugh P. Baker, who for nearly two years has been serving as a captain in the U. S. Army, has been released from service and has returned to resume his duties as dean of the New York State College of Forestry at Syracuse University. On account of an injury and because of his special training, Captain Baker had far the last few months been assigned to special investigative work for the Intelligence Bureau of the General Staff at Washington, D. C. Professor F. F. Moon, of the New York State College of Forestry at Syracuse University, who has been dean of the college during the absence of Dean Hugh P. Baker, has on the return of the latter to his work, been granted a year's leave of absence to begin immediately.

At the school of mines of the University of Missouri Carroll R. Forbes, major of engi-

neers, will return to his work as professor of mining on January 3; Charles Yancy Clayton, who has been working in the Bureau of Mines at Pittsburgh, Pa., on metallographic work for the Ordnance Department, will resume his duties as assistant professor of metallurgy; Captains E. S. McCandliss, F. E. Dennie and Lieutenant R. S. Lillard, of the mines faculty, are with the U. S. Engineers Army of Occupation in Germany, and Captain F. H. Frame, assistant professor of physics, is with the Ordnance Department in France.

Dr. Lafayette B. Mendel, professor of physiological chemistry at Yale, is attending the meetings of the Inter-Allied Food Commission in Europe.

Dr. H. N. Holmes, of the chemistry department at Oberlin College, has been released from part work in order to carry out research for the National Research Council, having been appointed a member of a National Committee of four on colloids.

Captain W. A. Felsing, Ph.D., has been appointed adjunct professor of chemistry at the University of Texas. He has been stationed for some time past at the government arsenal at Edgewood, Md.

Captain Paul J. Hanzlik, Medical Corps, U. S. A., chief of the Dermatological Unit, Chemical Warfare Service, Camp Leach, American University, has returned to his position of assistant professor of pharmacology, School of Medicine, Western Reserve University.

Raymond L. Barney, scientific assistant at the Homer station of the U. S. Bureau of Fisheries, has been promoted to be superintendent and director of the Beaufort, N. C., biological station, to succeed S. F. Hildebrand, who was promoted last July to be superintendent of the Key West (Fla.) biological station.

At its last meeting the Rumford Committee of the American Academy of Arts and Sciences voted an appropriation of $250 to Dr. Louis T. E. Thompson, of Clark University, for the development of a gun-sight with two magnifications, for application to anti-aircraft guns.

Miss Elizabeth S. Wehrick, for the past eight years instructor in chemistry at Pratt Institute, Brooklyn, N. Y., has resigned her position there to take up the work of textile chemist in the chemical laboratories of Sears Roebuck and Company, Chicago.

Mr. John E. Schott, formerly an industrial fellow at Mellon Institute, has accepted a position with the Experimental Division of the Hercules Powder Co., Kenvil, N. J.

Dr. H. N. Whitford has recently returned from a six month's trip in the southern part of Brazil, made in behalf of the Yale Forestry School. While there he was engaged in propaganda work in forest conservation and investigative studies. He had occasion to visit one of the largest hard wood sections in the states of Espirito Santo and Minas Geraes. He also spent some time in the Araucaria forests of southern Brazil. This latter is the largest coniferous forest in the southern hemisphere.

Dr. J. J. Galloway, of the department of geology of Columbia University, spent the past summer in the Mexican states of Yucatan, Campeche and Quintana Roo, studying the geology and petroleum resources of the peninsula.

Dr. L. H. Bailey is working at the Gray Herbarium of Harvard University completing the determinations of the collection of plants he made in China in the spring of 1917.

Mr. C. T. R. Wilson has been elected president of the Cambridge Philosophical Society. The vice-presidents are Dr. Doncaster, Mr. W. H. Mills and Professor Marr.

At the annual meeting of the Royal Society of Edinburgh Dr. J. Horne was elected president. Vice-presidents were elected as follows: Professor D'Arcy Thompson, Professor J. Walker, Professor G. A. Gibson, Dr. R. Kidston, Professor D. Noël Paton and Professor A. Robinson.

The Swiney lectures on geology of the Royal Society of Arts in connection with the British Museum (Natural History), are given

during December and January by Dr. Thomas J. Jehu. The subject of the course, which consists of twelve lectures, is "Man and his ancestry."

Professor J. Paul Goode, of the University of Chicago, gave an address entitled "The Prussian dream of world conquest" at the annual convention of the National Association of Investment Bankers, at Hotel Traymore, Atlantic City, December 9.

A memorial service for Samuel Wendell Williston, formerly professor of paleontology in the University of Chicago, was held at the university on December 8. The speakers were Professor E. C. Case, of the University of Michigan, and Professor Stuart Weller, of the department of geology and paleontology, and Professor Frank R. Lillie, chairman of the department of zoology.

B. O. Severson, associate professor of animal breeding in the Kansas State Agricultural College, died of influenza on December 4.

Captain Adelbert P. Mills, assistant professor of materials in the college of civil engineering, Cornell University, died at a hospital in France, on October 20, of cerebro-spinal meningitis, aged thirty-five years.

Louis C. Stern, a civil engineer, died on November 30, of pneumonia, following epidemic influenza, in Boulder, Col. Mr. Stern was connected for some years with the Bureau of Surveys of Philadelphia and with the Pennsylvania State Department of Health, in the supervision of water supplies and sewage disposal throughout the state. At the time of his death he was instructor in sanitary engineering at the University of Colorado.

Mr. Robert John Pocock, director of the Nizamiah Observatory, Hyderabad, died on October 9, aged twenty-nine years.

Nature states that the success of the British Scientific Products Exhibition, held at King's College, London, during the past summer, has led the British Science Guild to decide to organize another exhibition next year. The main object of the new exhibition will be to stimulate national enterprise by a display of the year's progress in British science, invention and industry.

Contests for the production of wheat of pure quality have been announced by the Italian Minister of Agriculture. All entrants must cultivate land in the Roman Campagna, and the kind of wheat to be grown must be selected from those announced by the Ministry which grew most favorably in that district. Contestants, to be eligible to the prizes must raise at least 20,000 pounds of wheat, of which at least half must be good for seed. The prizes offered are $400, $300, $240, $200, $160 and $100.

According to a press report an institute for scientific-technical research for problems connected with iron and steel manufacture is being established by the Ernesto Breda Company, of Milan. This is one of the first instances in Italy of the linking together of a scientific institute with an industrial concern. At the Breda plant in Milan new scientific theories and methods formulated in the institute for research will be tried out in the plants. The institute will offer to young men desirous of learning the iron and steel industry an opportunity of learning not only the science of metallurgy, but also its practical application. The establishment of the institute at the Ernesto Breda plant in Milan came in response to an appeal for the establishment of such institutes issued by the Scientific-Technical National Committee for Italy.

At the annual meeting of the Rhode Island Medical Society, the trustees of the Fiske Fund proposed the following subject for the prize essay for 1919: "Recent Classification and Treatment of Pneumonia." The prize for the best essay is $200. Each competitor must forward to the secretary of the trustees, on or before May 1 of the year of the competition, a copy of his dissertation. The trustees are Drs. Gardner T. Swarts, John M. Peters and Jesse E. Mowry, all of Providence. Dr. Peters is secretary.

A DINNER to celebrate the quartercentenary of the granting of its charter to the Royal College of Physicians of London by King Henry VIII was, as we learn from the *British Medical Journal,* held in France on September 23, and was attended by almost all of the Fellows of the College now serving in that country, to the number of something less than a score. The toast to the College was proposed by the chairman, Major-General Sir Wilmot Herringham, C.B., A.M.S., and a congratulatory address to the College was signed by those present.

THE American Public Health Association held its postponed annual meeting in Chicago, December 9 to 12. The program was designed to bring out all available information concerning the management of epidemic influenza, though other aspects of public health were not neglected. Among the papers on the program were: "Etiology of Influenza," by Major William H. Welch; "Mobilization of Medical and Nursing Forces," by Assistant Surgeon-General J. W. Schereschewsky; "Influenza and Pneumonia Vaccines," by Dr. E. C. Rosenow; "The Use of Sera in Influenza," by Drs. McGuire and Redden; "The Face Mask," by Colonel Charles Lynch and Dr. George Weaver; "Organization of State and Federal Forces in Epidemics," by Assistant Surgeon-General A. W. McLaughlin and Dr. E. R. Kelley; "History and Statistics of the Epidemic," by Assistant Surgeon-General B. S. Warren.

THE U. S. Civil Service Commission announces an open competitive examination for specialist in animal husbandry and dairying at an entrance salary ranging from $1,800 to $2,500 per year. This examination is scheduled to fill a vacancy on the editorial staff of *The Experiment Station Record,* States Relations Service, U. S. Department of Agriculture, and the duties of the appointee will consist mainly of the preparation of technical abstracts of the current scientific literature in animal husbandry (including animal breeding and feeding) and dairying (including dairy farming). Competitors will not be required to report for examination, but must submit applications and other material on or before January 7, 1919.

THE Bureau of Standards has published a "Metric Manual for Soldiers," the aim of which is to give to the American soldiers the grasp of the metric system which will enable them to think and work in metric units. As recommended no tables of equivalents need be memorized. Brief tables and a vocabulary are given for reference. The units are described by actual examples likely to be encountered in military work.

THE comet discovered by Professor Schorr, of Hamburg Observatory, on November 23, was observed on November 30 from the Naval Observatory at Washington, and the Yerkes Observatory in Wisconsin, according to telegrams received at the Harvard Observatory. The comet is very faint, being of the fourteenth magnitude, and is visible only in large telescopes. It is in the constellation Taurus, not far from the bright star Aldebaran.

ANNOUNCEMENTS have been made in the *Journal* of the American Medical Association of a Spanish edition, the initial number of which will appear early in January. For the time being it will be issued semi-monthly. It is proposed to include in it practically all the scientific matter that appears in the *Journal.* Original articles and editorials that are of local or ephemeral interest will not be included.

UNIVERSITY AND EDUCATIONAL NEWS

THE sum of £20,000 has been given to the George Watson's College, Edinburgh, by Mr. James Glass, of London, in aid of the establishment of a school of chemistry at that institution.

THE faculty of medicine of Western University, London, Ont., is planning the erection of a new medical college building at an estimated cost of $100,000.

A RESEARCH fellowship of the annual value of £150 has been founded at Guy's Hospital in

memory of the late Lieutenant R. W. Poulton Palmer and his sister, the late Mrs. E. H. A. Walker, the object of which will be the investigation of obscure diseases in man.

A fire on the night of December 17 in the basement of Havermeyer Hall, the chemical laboratory of Columbia University, caused damage estimated at $10,000.

Dean Edward A. Birge has been elected president of the University of Wisconsin to succeed the late Charles R. Van Hise. Dean Birge will serve for two years, when he expects to retire at the age of seventy. He has been a member of the Wisconsin faculty in the department of zoology since 1875, and served as acting president of the university from 1900 to 1903.

Dr. Harold C. Chapin, of the National Carbon Company in Cleveland, has accepted an associate professorship of chemistry at Lafayette College.

The title of emeritus professor of experimental philosophy has been conferred upon Dr. E. H. Griffiths, F.R.S., on his retirement from the principalship of the University College of South Wales and Monmouthshire.

DISCUSSION AND CORRESPONDENCE

AGE FLOW AND EBB OF THE EOCENE SEAS

We will agree with geologic writers from Wm. Smith's day to this that a typical geological cycle consists of a sequence of arenaceous, argillaceous and calcareous deposits, the strandline moving in as deposite-load increases; in place of littoral sands, clear-sea, calcareous matter eventually becomes dominant.

During the minor subdivisions of geologic time, the ages, for example, wherever continental shelves are very broad and near sea-level, slight changes of this datum plane may produce enormous strand-line shifting without bringing about extensive lime-forming conditions; clays will alternate with sand *ad infinitem*, characterized now by the life of the ocean's flood, now by swamp life during its ebb.

Our southern Eocene deposits seem to record three such flood stages, separated by two ebb stages.

1. *The Midway Stage* is the oldest, the most generally *marine* with an expanse of gulf waters stretching from South Carolina through west Tennessee and perhaps southern Illinois, thence through Arkansas, southwest to and beyond the Rio Grande.

2. *The Sabine* records the first ebb tide condition over this same great area, a condition conducive to the growth of swamp vegetation, hence the *lignitic* condition of the strata as we see them to-day.

3. *The St. Maurice Stage* records the second notable and generally *marine* condition over much of this area, though extending less deeply into the Mississippi Embayment.

4. *The Claiborne Stage* appears to be, save in Alabama itself, a second great *lignitic* formation. Even at Claiborne, just above the Upper Landing, a road-cut shows the famous marine "sand bed" invaded by lignitic materials.

5. *The Jackson Stage* may well be looked upon as the last and in some ways the most remarkable of the *marine* accumulations. A quarter of a century ago we marked out a great transgressional loop of this stage up into eastern Arkansas but there were then no known evidences of its occurrence in Texas. But the keen eyes of A. C. Veatch soon discovered such evidences in east Texas; others have made valuable contributions in the same direction, and it is quite likely that the *Ostrea contracta* (*georgiana*) beds on the Rio Grande are of this age. To the east, in Florida, Georgia and the Carolinas, Cook is doing yeoman's service in expanding our knowledge of this great terrane.

Our conclusions in tabular, condensed form appear thus:

Stage	Water Condition	Sediment
Jackson	*Flood*	*Marine*
Claiborne	*Ebb*	*Lignitic*
St. Maurice	*Flood*	*Marine*
Sabine	*Ebb*	*Lignitic*
Midway	*Flood*	*Marine*

The Potomac Basin seems to have been generally too deep to show similar responses in

character of deposition to slight changes of sea-level. Downwarped in Sabine times (in areas where now accessible) it remained flooded till into St. Maurice times without showing very rapid, or well-defined, sharp changes, faunal or lithological.

Vertebrate paleontology assures us that the holarctic waters have been somewhat drained off now and then during Tertiary times, else land areas have risen out of the seas, furnishing bridges for mammalian migration between the New and Old worlds. The correlation of holarctic with Gulf age tides is a fascinating problem for contemplation, if not for solution by present-day earth-science workers. Perhaps our co-workers on the West Coast may have arrived at some general conclusions regarding tide-level conditions there during the Eocene ages. These, it seems to the undersigned, might be of vast importance for working out the physical history of our Eocene series.

G. D. Harris

Paleontological Laboratory,
Cornell University,
December 5, 1918

HEREDITARY DEFICIENCIES IN THE SENSE OF SMELL

Blakeslee[1] has recently drawn attention to the fact that two individuals may exhibit marked degrees of sensitivity to the fragrance of verbena flowers. A given person, asked to judge between the blossoms of two plants, A and B, may declare the former fragrant but not the latter. From a second person we may get exactly the opposite response. To him B is fragrant but not A.

These differences which were found repeatedly and which seem to have been constant, suggest numerous interesting problems. They also serve to recall that practically nothing is known, or if known, at least not readily accessible to the general reader, on the heritability of differences in the sense of smell.

I have been asked on several occasions what might be expected from a mating involving a normal person and one devoid of a sense of smell and, until asked the first time, I did not know that there are people who not only can not recognize the difference between odors, but can not recognize odors at all.

Not long ago, an instance of this sort fell into my hands and though the family history is fragmentary, it may possibly, when pieced in with other fragments, acquire some little value.

The case in point is that of a young Russian Jew, a fugitive from Kiev. This man, M. is quite unable to distinguish odors in the usual way. Alcohol, or anything with a sufficiently high percentage of alcohol, is simply "felt." The same thing is true of illuminating gas. Ether and chloroform, when very concentrated, "choke"; when dilute, they produce a "feeling" similar to that caused by flowers. The latter, also, he is aware of, but not in the ordinary way. They emit, very decidedly, "something delicate"; but this something is registered as "a gentle sensation like breathing balmy air." Pepper, again, has "no odor," but it is irritating and its application is followed by the usual effects.

The M. family, one characterized incidentally by much stammering; by an early and complete loss of the incisors; by frequent hernia; a thumb nearly twice the normal width; excessive sex interest; and, very considerable mental powers, contains several individuals abnormal in their sensitivity to odors.

Among the immediate sibs of M. himself, two sisters are normal in this respect. One brother exactly duplicates M. and another has some slight capacity in detecting odors. The mother of these sibs was unable to detect odors and her father, in turn, is reported to have been similarly deficient.

Off-hand there are certain resemblances here to sex-linked inheritance. It is necessary only to assume that the mother had the necessary double dosage in order to have a fairly typical case. Moreover the likelihood of this interpretation being correct is enhanced by a circumstance which to some may appear to cloud

[1] "Unlike Reactions of Different Individuals to Fragrance in Verbena Flowers," A. F. Blakeslee, Science, N. S., Vol. XLVIII., p. 298.

the issue, namely, M. has a cousin defective in the same sense. This cousin is the daughter of a paternal aunt whose husband, from quite another family, is "smell-blind."

"After making inquiries," M. writes," among people I know to be from my former place of residence, I came to the conclusion that that locality inbreeds this defect so that quite a number are afflicted with it."

This, in case the trait is sex-linked, is exactly the condition necessary to explain the relatively large number of duplex females herein recorded.

Whatever may or may not be true, the trait has reappeared in one collateral and two direct generations. This is sufficiently frequent to warrant the assumption that "smell-blindness" is heritable, and, from its behavior in this pedigree, it should not be very surprising if further evidence were to place it in the list of sex-linked characters.

Otto Glaser

Department of Biology,
Amherst College

BIOLOGICAL PRINCIPLES IN THE ZOOLOGY COURSE

In an article entitled "Botany after the War," Professor Bradley M. Davis[1] discusses the changes which a period of war adjustment is likely to bring to the teaching of botany in introductory courses. It is not necessary to read between the lines to detect that Professor Davis will welcome the changes that he anticipates. His interest is chiefly directed to the relegation of morphology—especially the morphology of types—to a less commanding position then it now enjoys. His general thesis is well embodied in his closing interrogation whether the first course will not "come more and more strongly to stand out as one that attempts nothing more than the grounding of fundamental principles and a selection of information with rather definite reference to its general and practical interests, or its broad philosophical bearing."

The writer has not followed the discussion in the *New Phytologist*, but the reference to it made in the cited article leads him to infer that the ideal course in botany has been realized in few, perhaps none, of our institutions. Such an inference with regard to botany seems not at all unnatural to one who is acquainted with the situation in the teaching of its sister science zoology. In the latter subject the type course has long been the dominant one, almost the exclusive one, an inheritance from the time when zoology was a purely morphological science. Several books, it is true, have been in recent years described by their authors as the product of a revolt against the type course; but they mostly contain internal evidence that the laboratory courses which they accompany in the authors' own laboratories still consist largely of the dissection of types. While these teachers recognize that fundamental principles, rather than a knowledge of animal types, is the desirable acquisition of the beginning student, they have not had the courage to make that acquisition possible in the laboratory as well as in the recitation and lecture.

There is no fundamental reason why the work of the laboratory may not be grouped exclusively around general principles instead of around phyla and classes. Why allow demonstration of the tenets of the cell doctrine to be picked up piece-meal in several courses when a brief exercise on a number of unrelated organisms accomplishes the same purpose more completely at the outset? The simpler activities of protoplasm may be studied even by beginners, by introducing at one time organisms from widely different groups. The first-hand study of the principles of ecology does not require a knowledge of large animal associations, but can be satisfactorily based upon two or three forms taken from different phyla; and it is seldom necessary to know regarding any one of these animals more than a small fraction of the anatomical facts which a type course would include, to explain for the beginner the relation of that animal to its habitat. In the type course homology must be taught very incidentally in almost arbitrary connection with some one form, or must wait until

[1] Science, N. S., Vol. 48, November 22, 1918, pp. 514–516.

a number of closely related types have been dissected; and in the meantime the student is endeavoring to assimilate a classification without a knowledge of the chief practical means of establishing a system of taxonomy. Nor is taxonomy itself necessarily excluded when types are abandoned. An exercise in which the principles of taxonomy are made clear by illustrative material from the whole animal kingdom gives the student a better conception both of classification and of the groups of animals than anything less than a very long type course could be expected to do. And finally, the argument that a type course exhibits a splendid evolutionary series loses its force when types may be supplanted by much better evidence from vertebrate and invertebrate fossils, from geographical distribution, and other sources. Moreover, certain phyla, as the echinoderms, never did have much evolutionary significance, when taken in connection with other phyla, yet the usual type course includes at least one echinoderm.

The objection is sometimes raised that a course based on principles instead of types gives a full knowledge of not a single animal. This objection, however, comes only from those to whom zoology has a special interest, and who will go on for advanced work in the same field; and in their second course they will get that complete information about some one animal which they desire. An elementary course based on principles should therefore be the best foundation for students of all grades of interest. To him who will never pursue another course in biology it gives the very things that will be of interest or value. To him who will specialize in the subject, it affords the best possible framework into which the details subsequently acquired can be fitted.

Unlike courses in elementary botany, if Professor Davis's paper is correctly interpreted, the course in zoology based on principles does not await the future for its realization. In at least one institution such a course is now in operation. In the University of Michigan the first course in zoology is of the kind described. Dissection of types is no longer practised, the entire laboratory work being collected around principles. It is a truly general course; first hand knowledge of the elementary facts from each of the main divisions of zoology is gained in the laboratory and from these facts fundamental principles are derived. It has been in operation for several years, and has more than justified its introduction. Such a course makes new demands on the text-book and on the mode of teaching, but these difficulties can be removed. It is likely to be a little more expensive to install than the type course, but its current expenses may well be less.

The sponsors of this course regard it as the best kind of course, whether after the war, during the war, or any other time. Whatever of practical or applied biology it contains is there, not for any benefit that may accrue to the nation in times of stress, but because of its general interest and importance. For it is clear that the amount of applied biology that could be included in a beginning course would not enable any one save his country, unless increased by practical courses to follow.

In pedagogical method the course on principles need not differ from the type course. The inductive method may be as consistently employed. Accuracy in observation is just as necessary. Correctness of interpretation is quite as essential. But this difference exists: the thing observed is itself of interest, or the interpretation is important. Features of an animal which are not of interest or are not important are omitted.

A. FRANKLIN SHULL
UNIVERSITY OF MICHIGAN,
ANN ARBOR, MICH.

INTERNATIONAL ORGANIZATION OF SCIENCE

TO THE EDITOR OF SCIENCE: The statement adopted by the Inter-Allied Conference held in London under the auspices of the Royal Society, SCIENCE, November 22, page 509, as a preamble to certain resolutions which are to be made public later, directs attention to the serious difficulties which the recent war has imposed on the international scientific projects already inaugurated and on those under consideration. As these projects are of common interest it can scarcely be expected that a

certain set of resolutions adopted before the close of the war will furnish a final solution of these difficulties, notwithstanding the eminence of those directly concerned in drafting or in adopting the resolutions.

The great scientific progress since the Middle Ages has been largely due to the separation, mental or statutory, of concepts or institutions of fundamental human interests. As instances, we may refer to the separation of church and state, of knowledge and superstition. It would seem very unfortunate if we should now allow moral and ethical questions to becloud our vision as regards scientific merits or demerits. We all welcome exposures of unfair scientific dealings practised persistently by such large numbers as to constitute national characteristics, but if these exposures are to be really effective they should bear evidence of the fact that the accused had a fair chance to defend themselves. Hence the need of open international scientific conferences seems to be greater now than before the war.

G. A. Miller

QUOTATIONS

A NATIONAL LABORATORY FOR THE STUDY OF NUTRITION

A resolution of the Inter-Allied Scientific Food Commission, which does not appear to have attracted as much notice as it deserves, dealt with the need of establishing national laboratories for the study of human nutrition. The commission pointed out that, as at least one quarter of the whole income of a nation was devoted to the purchase of food by its individual citizens, it was a matter of the highest importance for the welfare and prosperity of a country that the methods of utilizing its food resources in the best way should be explored and definitely established on the basis of scientific data. The commission therefore adopted a resolution urging the allied governments to establish national laboratories to be devoted to the task. There is no doubt that the want of such a laboratory will be especially felt in the United Kingdom, where the husbanding of our food resources is likely to remain imperative longer than in countries which are normally nearly self-supporting.

The contrast between the extent to which the study of human metabolism has been fostered by the state or left to private enterprise in England and the United States is little to the credit of our rulers. Nor can it be pleaded in extenuation of the neglect that English men of science have shown no signs of being attracted by the problems of nutrition and metabolism. On the contrary, without any depreciation of the labors of such Americans as Atwater and Benedict, or such Germans as Rubner, we can justly claim that the present generation of English physiologists has made contributions to the science of nutrition equal in value to anything which has been achieved elsewhere. We need merely cite the brilliant researches into the chemical mechanisms of digestion which we owe to Starling and Bayliss, the work of Hopkins and his pupils on protein metabolism, and the succession of important contributions to the study of deficiency diseases which have come from the laboratories of the Lister Institute, culminating in the recent work of Dr. Chick and her collaborators.

Since the war the Royal Society, by the agency of its food (war) committee, has, with little official aid and, at times, in spite of official indifference or neglect, done much to bring the subject of national dietetics under proper scientific guidance, but we are of opinion that its work will not be extended and made of permanent value to the nation unless effect is given to the Inter-Allied Commission's proposal.

We shall endeavor to make the reason plain by considering one only of the topics within the scope of nutritional research. The Inter-Allied Commission mentioned the need of determining the amount of food required to maintain the health and strength of persons engaged in different occupations. As we had to point out some time since, when the policy of the food controller received less inspiration from scientific sources than has happily been the case during the past twelve months, the broad distinctions between class and class, the

general laws of human energetics, have been long established. But details which are of great importance when any exact view of the subject is desired, still escape us. To express the energy requirements of agricultural laborers in terms of food with the precision attainable by an actuary in estimating their average expectation of life is still an ideal of the remote future. This is only in part due to the greater difficulty of measuring energy transformations as compared with the measurement of longevity. It is now quite possible by means of relatively simple apparatus to carry out such determinations on a large scale. But the task is not one that any private investigators can be expected to undertake. The mere compilation of statistics of family consumption, a less laborious affair, occupied much of the time of the United States food investigators for years. Here is a proper object for the team work of which so much is heard in these times. It involves physiological skill both in making the measurements themselves and in paying due heed to the attendant circumstances, such as the cooling power of the air in the factory or workshop, a point scarcely heeded by many past students; industrial knowledge is needed to decide what factory processes are *in pari materia* so that representative samples may be chosen for experiment; lastly, some experience in the handling of numerical data is required to decide the significance of departures from the average and the limits of precision of the averages themselves. Nor does it suffice to enroll a suitable team of investigators and send them out into the factories to collect data. The routine application of a physiological technique is the death of science. When a method is intelligently applied upon a large scale anomalous results must emerge, the analysis of which upon a laboratory scale and with the attendant simplification of the conditions may lead to the discovery of new and important truths. The investigating staff must be attached to a headquarters laboratory controlled by a physiologist competent to sift real anomalies from mere technical errors and to cause them to be sedulously investigated. We conceive that in this way alone a really adequate knowledge of the energy requirements of muscular work can be attained.

When it is remembered that this problem, important as it is, is only one of the problems of human nutrition which are still unsolved, we do not think more need be said in support of a national laboratory of nutrition. No doubt the time will come when the intelligent citizen will find it difficult to understand how any nation could neglect to make such a provision for its literally vital needs.—*British Medical Journal.*

SCIENTIFIC BOOKS

An Outline of the History of Phytopathology. By Herbert Hice Whetzel. Philadelphia and London, W. B. Saunders Company. 1918. Pp. 130, with 22 portraits.

The domain of plant pathology is rapidly taking shape as a highly important part of the contribution of botany to the economic life of the world, as well as a department of botanical science demanding recognition from students of the modern aspects of science in general. The enormous losses which crops suffer from parasitic and predatory fungi have long been recognized in a general way, but only in recent years, since numerous investigators have undertaken to study the causes which inhibit the optimum development of cultivated plants, has the great diversity in the etiology of plant diseases been so clearly shown. With the recognition of the diseases and their causes has grown up practical means for controlling or avoiding many of them. The economic returns have reacted upon the opportunities for investigation, and consequently great progress has been made in this department of botany within the few decades just past, more especially in America. The epidemic of the chestnut blight, the fight against the white pine blister-rust, the barberry-wheat campaign, and the government and state quarantine acts against the importation of diseased plants, have brought the subject home to every one.

The pioneer work by Professor H. H. Whetzel, of Cornell University, on the history of

phytopathology is therefore a timely and serviceable contribution. The subject is treated by Professor Whetzel in an attractive and perspicuous manner, and covers from the most ancient times to the present. Both the development of concepts regarding the nature and treatment of diseases as well as the dominating influence of phytopathological writers are taken into consideration in dividing the time into eras, and again into periods.

Scarcely thirty pages are given to the three incubation eras, called the Ancient, Dark and Premodern Eras, but they are most readable pages, and clearly point out the course of the early development of the subject.

The Modern Era, extending from 1853 to 1906, was one of great activity in all scientific lines. During this time phytopathology became a distinctive science. Many investigators of forceful personality and marked ability gave direction to the work of discovery, and in consequence the boundary of knowledge in the field of plant diseases was enormously extended. The center of pathological activity in its academic aspects was at first in Germany, and in its practical and commercial aspects in France, but in both aspects the foremost advance began to shift to America in the eighties, and soon this country became the leader in initiative as well as in the amount of investigation.

The present era, now just entering its second decade, has seen the establishment of chairs of phytopathology in many universities, the rise of the American Phytopathological Society and of the journal *Phytopathology*, the enactment of effective quarantine measures against the international and interstate movement of diseased plants, a new class of fungicides with sulphur in place of copper, the discovery of the canceroid nature of crown gall, and in general the recognition by men of affairs as well as by the cultivator of the vast importance of the utmost detailed information regarding plant diseases and of cooperative and efficient means for making such knowledge available in protecting all sorts of crops and plant life.

This orderly presentation of the evolution of a science destined to play an increasingly wider and more important part in the affairs of human well-being and achievement is particularly timely. Professor Whetzel has compressed into the hundred and thirty pages of his book a well balanced and helpful outline of the historical aspects of the science. It is a valuable addition to botanical literature.

J. C. Arthur

Purdue University

SPECIAL ARTICLES

RESISTANCE IN THE AMERICAN CHESTNUT TO THE BARK DISEASE

During the past summer, in connection with the Office of Forest Pathology, U. S. Department of Agriculture, the writer investigated conditions in the American chestnut looking toward immunity or disease resistance to the well-known bark disease. A thorough search was carried on, which, for obvious reasons, was restricted mainly to the immediate neighborhood of New York City. The results are deemed of sufficient importance to warrant publication here in advance of a more detailed account.

No immune trees were found, but a considerable number of resistant trees were located, some of them on the island of Manhattan itself. The following points are considered evidence of a resistant quality in these trees.

1. The result of inoculation tests. The average lateral growth of the fungus in 289 inoculations was 0.6 cm. for a period of from 5 to 6 weeks—mainly in August. This is about one fourth the figure (2.2 cm.) given by Anderson and Rankin for normal trees during the month of August at Napanoch, New York, and about one fifth the figure (2.83 cm.) given for the same month by the same investigators at Charter Oak, Pennsylvania.[1]

2. The occurrence of the trees in a neighborhood long subject to the disease, and the presence among the trees of individuals long since dead.

[1] Anderson, P. J., and Rankin, W. H., "Endothia Canker of Chestnut," Cornell Univ. Agric. Expt. Sta. Bull. 347, pp. 574, 575, 1914.

3. Evidence of the long period the disease has been present in the trees themselves; *i. e.*, bare, weathered tops; *healed* cankers; thrifty branches, with bases diseased and hypertrophied, but living, etc.

4. Peculiarities of the bark; such as extensive development of a callus tissue, and the presence of a peculiar substance which is constantly associated with, and particularly conspicuous in cases of marked resistance.

5. The natural grouping of the trees in well-defined areas or "pockets," pointing to a genetic variation.

6. The manifestation by members of the same coppice group; and by branches, trunk and basal shoots of the same individual; of similar degrees of resistance, indicating an inherent condition.

If these facts and inferences are correct, they point the way clearly toward a reconstruction and a revival of our American chestnut. Many of the trees bloomed well, and this fall bore good fruit. A large number of nuts have been gathered and planted by Dr. Van Fleet, of the U. S. Department of Agriculture, at the trail grounds near Washington, D. C. If the resulting seedlings substantiate the inference that the disease resistance is a heritable character, the way lies open, both by inbreeding, and by crossing with the resistant oriental species (not good timber trees themselves) to develop an extremely resistant or perhaps practically immune strain of timber tree for the reforestation of our devastated chestnut woodlands.

ARTHUR HARMOUNT GRAVES
OFFICE OF INVESTIGATIONS IN FOREST PATHOLOGY,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

THE OCCURRENCE OF AZOTOBACTER IN CRANBERRY SOILS

SEVERAL papers have appeared recently in SCIENCE and elsewhere[1, 2] concerning the fact that the aerobic non-symbiotic nitrogen fixing organisms, namely the *Azotobacter* group, occur in the soil, when the concentration of the hydrogen-ion is not more than 10^{-6}, or the limiting exponent is 6.0.

Investigators[3] have gone so far as to use the presence of *Azotobacter* in the soil as an indication of the soil reaction. Gillespie,[2] interpreting the results of Christensen,[3] stated that they are in accord with those obtained by Gainey,[1] namely the limiting hydrogen-ion exponent for the presence of *Azotobacter* in the soil is 6.0.

The methods previously used in determining the soil acidity conveyed only a very indefinite idea about the true nature of the reaction of the soil. But only recently [4, 5] methods have been suggested which, either using the electrometric or an improved colorimetric method, have enabled us to get a better insight into the extent and nature of soil acidity. These studies have brought out the facts referred to above concerning the reaction limit for the existence of *Azotobacter* in the soil.

In the study of the microbial population of cranberry soils some interesting observations were made and of these only the occurence of *Azotobacter* will be reported here.

The cranberry soils are so distinctly different from ordinary soils that it was thought for a long time that no very large number of bacteria can exist in them and that the microbial population consists predominantly of molds. These soils are known to have a distinctly acid reaction and contain large quantities of undecomposed organic matter, namely the roots and the stubble of the dead plants. The existence of *Azotobacter* in cranberry soils would be of great practical importance, since the nitrogen of the air would thus be fixed and made available to the crops, which have to grow in soils rather poor in available nitrogenous constituents (particularly is this true of sandy bottom bogs). The undecomposed roots and stubble would supply the carbohydrates necessary for the activities of *Azoto-*

1 Gainey, SCIENCE, Vol. 48, pp. 139–140, 1918; *Jour. Agr. Res.*, Vol. 14, pp. 265–271, 1918.

2 Gillespie, SCIENCE, Vol. 48, pp. 393–394, 1918.

3 Christensen, *Soil Science*, Vol. 4, pp. 115–178, 1917.

4 Gillespie, *Jour. Wash. Acad. Sci.*, Vol. 6, pp. 7–16, 1916.

5 Sharp and Hoagland, *Jour. Agr. Res.*, Vol. 7, pp. 123–145, 1916.

bacter, particularly in the presence of cellulose decomposing organisms.

The high acidity of the cranberry soils would preclude the very idea of finding the *Azobacter* in these soils and the early students[6] of this group of organisms were of the opinion that they can not live in acid media at all but the reaction has to be adjusted first to neutrality before the conditions are made favorable for their activities.

A Savannah bottom cranberry bog situated at Whitesbog, N. J., was used for this work. A part of the bog was limed three years ago and the crop was almost double of the corresponding plot, unlimed. Samples of the soil from the two plots were secured under sterile conditions and used for this study. The soil is nothing more than some white sand interwoven with decayed and living plant residues.

The hydrogen-ion concentration of the two soils was determined by means of the colorimetric method, using the phenol-sulfon-phthalein indicators suggested by Clark and Lubs.[7] The method corresponds very closely with the electrometric determinations using the hydrogen electrode, as was shown by Gillespie.[2] A definite amount of soil was shaken with double its weight of distilled water, then centrifuged; the supernatant clear liquid was syphoned off and used for the determination of the hydrogen-ion concentration. The unlimed soil had an hydrogen-ion concentration of pH = 5.4 to 5.6 while for the limed soil pH was 6.2—6.4.

The two soils were added in 10-gram quantities to 100 c.c. portions of a sterile faintly alkaline nitrogen-free mannite solution and incubated at 25°. The solution in the flasks containing the limed soils became turbid in four days and a pellicle characteristic of *Azotobacter* began to develop in some flasks. On microscopic examination the solution was found to contain an abundance of *Azotobacter* cells and *Actinomyces* filaments. The solution in all the flasks to which the unlimed soil was added remained clear as in the control, but has shown a profuse gas production. On microscopic examination no *Azotobacter* cells and no *Actinomyces* filaments were discovered.

The limiting reaction for the existence of *Azotobacter* in the soil, expressed in the hydrogen-ion concentration is thus found to fall between pH—5.4 to 5.6 and pH—6.2 to 6.4 and is probably nearer the latter. This will confirm the results of Gainey[1] and Christensen[8] that an hydrogen-ion concentration of the soil = pH—6.0 is the limiting reaction for the activities of *Azotobacter* in the soil.

The occurrence of *Antinomyces* filaments together with *Azotobacter* cells suggests a still more interesting and important possibility, association between these two groups of soil microorganisms. As will be soon shown elsewhere many *Actinomyces* decompose organic residues very rapidly. The association between these two groups of organisms, change of reaction, and the action of *Actinomyces* upon the nitrogen-fixation by *Azotobacter* is being studied at present in this laboratory.

The importance of *Azotobacter* in cranberry soils, which can be effected by changing the reaction of those soils, thus becomes apparent: these organisms, whether alone or in association with others, utilize the plant residues as a source of energy and this allows them to fix the atmospheric nitrogen and increase its supply in the soil, which goes towards an increased crop production.

Selman A. Waksman

N. J. Agr. Exp. Station,
New Brunswick, N. J.,
November 2, 1918

[6] Lipman, *Ann. Rept. N. J. Agr. Exp. Sta.*, pp. 262–268, 1904.

[7] *Jour. Bact.*, Vol. 2, Nos. 1, 2, 3, 1917.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter